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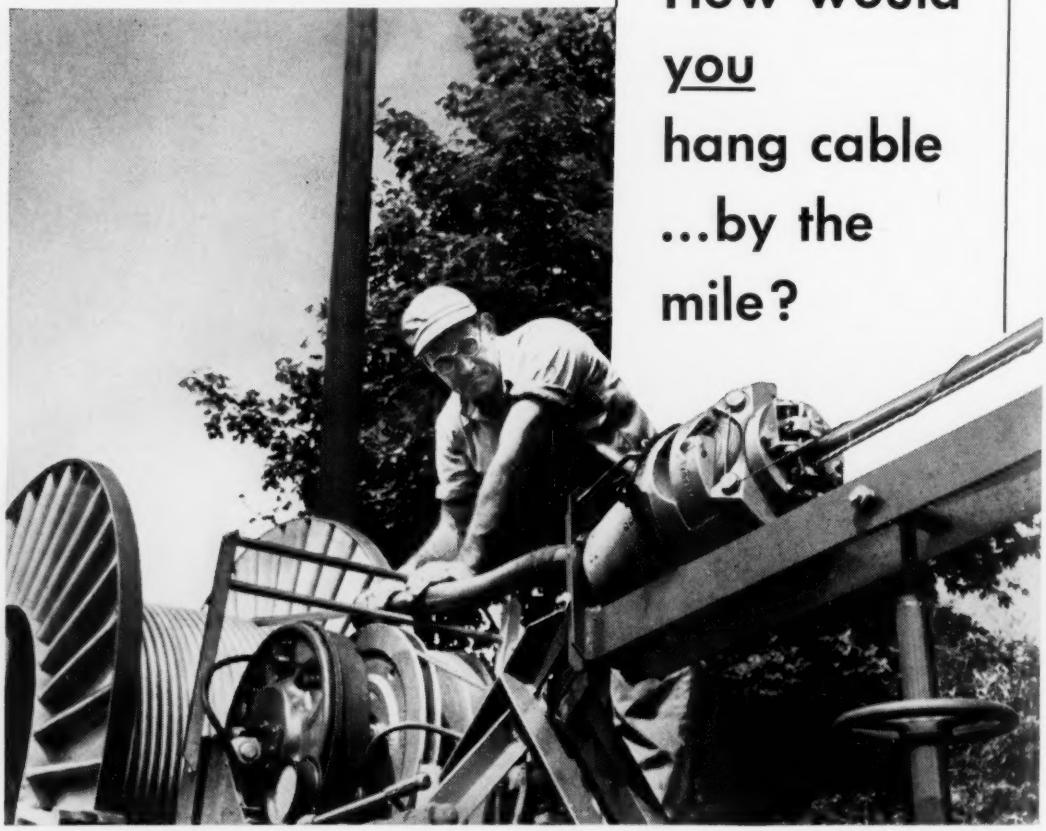
Cable lasher appears to right of workman. As the cable and supporting strand feed through, the machine rotates, binding them together with steel lashing wire. Meanwhile, a winch hauls the lashed cable into position.

How would you hang cable ...by the mile?



It is a job your telephone company faces every day. Thousands of miles of cable go up each year—all secured to steel strand running from pole to pole. The best way to secure cable is to *lash* it to the strand with a spiral binding of wire.

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Science and Technology

(From the Month's News Releases)

Acoustical Plastic

Acoustical plastic, applied over existing ceilings, absorbs sound and provides insulation and fireproofing. The material's key component is vermiculite, a granular micalike mineral that not only is incombustible but also retards the spread of flame. It is well suited for use in homes, offices, auditoriums, hotels, radio and TV studios.

Bibliography on Electrophoresis

A comprehensive bibliography on electrophoresis and related analytical methods such as diffusion studies, absorption chromatography, and electrophoresis convection, carefully organized for rapid and easy reference, will soon be made available to scientists and institutions. By the latest count, more than 2200 titles of papers which have appeared in domestic and foreign periodicals are listed in the bibliography. The number of authors has passed the 2000 mark. The references range from those which date back to the earliest explorations in electrophoretic theory in the nineteenth century to papers appearing through mid-1953. It is planned to keep the basic bibliography up to date and to issue supplementary editions from time to time.

Floating Knife

For the Izaak Waltons is offered a knife that floats. The stainless steel blade is surrounded by 1¾″ of cork and on the back of the blade is a scaler for removing the scales from the fish. There is also sunk into this knife a shackle for attaching the knife to the fisherman's belt, so that it will be handy when needed.

Fountain Brush

Now it's a fountain-type brush for washing your car, house, screens, storm windows, etc., without fuss or muss and in half the time. Made of soft horsehair bristle, the brush is connected to your garden hose to give you a soaking, scrubbing, rinsing operation all at one time. A rubber bumper around the aluminum head prevents scratching. A shut-off valve is built into the hose coupling on the handle. By turning the coupling, the valve regulates and shuts off the flow of water.

General Purpose Pump

Improved priming qualities and increased pump output with the same power is the result of a new impeller design, so says the maker. The pump case is rustproof bronze, and the pump is available in three models —½″, ¾″, and 1″ port sizes. Materials and design of the equipment permit pumping of kerosene and fuel oil. It will handle dirty water without clogging and may be operated with electric or gasoline motors, or a tractor take-off. The manufacturer recommends the pump for farm, industrial, marine, and home use and lists such applications as laboratory and machine shop transfer pumping, silo draining, cistern filling, barn flushing, bilge pumping, and basement draining.

Canal Liner

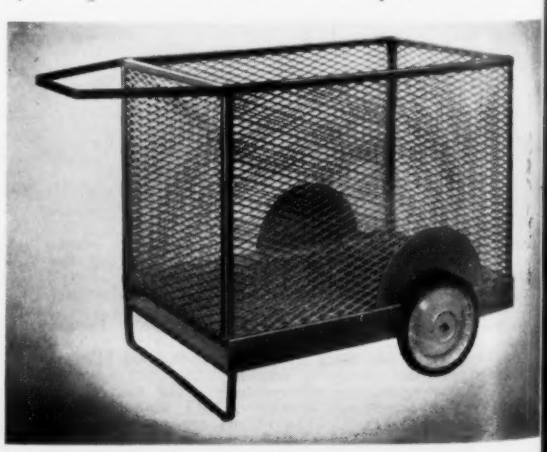
A prefabricated canal liner has been developed that protects against water seepage from irrigation systems, stock ponds, and reservoirs. It is made of asbestos and asphalt and will not rot or decay underground. The liner comes in easily installed rolls 3′ wide containing 108 sq ft per roll.

Scientific Packaging

A lined, cushioned bag has been designed to protect metal parts from rust and corrosion up to ten years, according to the manufacturer. Such protection is afforded by blanketing the metal with an invisible dry vapor. Moisture and air combine with the dry vapor, surround and cling to metal surfaces, and penetrate blind holes and cavities often overlooked in greasing. At the same time the cushioning protects the product from rough handling, dampness, and damage in transit. The bags may be marked for easy identification.

Itinerant Incinerator

A new addition to home gardening equipment is a portable leaf burner. Mounted on wheels the burner provides a safe and convenient way to dispose of dry burnable refuse such as leaves, papers, twigs, brush, and grass cuttings. It is constructed of heavy gage steel and is painted a bright aluminum to deter rust. The wheels are steel-based and are covered with wide rubber tires to prevent rutting of the lawn. The entire unit is so balanced that it can easily be pushed or pulled from place to place. A heavy gage steel ash collector is located below the burning basket to prevent scorching the lawn, and dumping of ashes is accomplished by tilting the handle of the burner upward.



THE
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JUNE 1953

The Black Madonna: An Example of Culture Borrowing*

LEONARD W. MOSS and STEPHEN C. CAPPANNARI

The authors are members of the faculty of Wayne University, in Detroit. Leonard W. Moss is an instructor in sociology and is a candidate for a Ph.D. degree at the University of Michigan. He spent two years in Italy with the 15th Air Force Intelligence during World War II. Dr. Cappannari is an instructor in anthropology and received his Ph.D. degree from the University of California, Berkeley. He is a Fellow of the American Anthropological Association.

Aphorism

"I am black, but comely,
O ye daughters of Jerusalem,
as the tents of Kedar,
as the curtains of Solomon.
Look not upon me because I am black,
because the sun hath looked upon me.
My mother's children were angry with me,
they made me the keeper of the vineyards;
but mine own vineyards have I not kept!

From the *Song of Songs*
which is Solomon's

THE existence of black madonnas in various parts of the world has been noted by many authors. It should be explained that some of the so-called black madonnas are not actually black, but are dark brown in color. We have classified these representations of the Virgin Mary in three distinct categories.

First there are the *dark brown or black madonnas with physiognomy and skin pigmentation matching that of the indigenous native population.* In this class we include such madonnas as Nuestra Senora di Guadaloupe Hidalgo in Mexico and the various Negroid madonnas found in Africa. Though the Catholic Church has never given official approbation to these art forms, they are tolerated, probably as one way of bringing the religion closer to these populations.

Second, there are *various art forms which have turned black as a result of certain physical factors.* The change may have been brought about by (*a*) deterioration of the paint pigment (some of these

* Based on a paper presented to the Anthropology Section of the AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, December 28, 1952, St. Louis, Missouri.

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madonnas have been repainted in flesh tones only to turn black again), (*b*) smoke damage stemming from the use of votive candles in areas adjacent to the statues, (*c*) smoke damage resulting from a fire in the church, (*d*) oxidation of the silver used in the construction of the image, and (*e*) other physical factors such as the accumulation of dirt over the ages.

Third, are the *miracle-working madonnas*. It is this class of madonnas that is investigated here. The hypothesis that there has been here an attempt to anthropomorphize the Virgin is not tenable, since the natives of these regions are Caucasoid. The various physical explanations cited in our second group do not seem applicable to this category. One must also discard the physical explanation, which may differ with the various madonnas under question. In such cases we find: (*a*) There is no evidence for physical deterioration of the pigment, no smoke damage, no oxidation, and so on. (*b*) Where there is evidence of such physical damage, the madonna has been repainted *black*.

The madonnas in this third category are found in such diverse locations as: Altötting, Bavaria, Germany (Our Lady of Altötting); Czenstochowa, Upper Silesia, Poland (Our Lady of Czenstochowa); Montserrat, Catalonia, Spain (La Santa Imagen, Our Lady of Montserrat); Einsiedeln, Switzerland (Our Lady of the Hermits); Chartres, France (Notre Dame du Pilier, La Vierge Noire); Tindari, Sicily (Madonna di Tindaro),* Enna, Castrogiovanni, Sicily (La Madonna della Grazia);* Lucera, Apuglia, Italy (Madonna della Spiga); Potenza Province, Basilicata, Italy (Santa Maria di Vigianno); Manfredonia, Apuglia, Italy (Santa Maria di Siponto);* Monte Vergine, Avellino, Italy (La Madonna di Constantinopoli).*

Of the eleven madonnas, we have felt it necessary to eliminate two from further consideration in the development of an hypothesis. Bavarian legends hold that the "Black Mother of God" at Altötting was preserved from smoke damage despite the ravishing of the church by flame in A.D. 907. The face, hands, and feet of this statue allegedly turned black "with age" at a later date. This explanation is deficient in that it fails to explain why the rest of the statue, in skin tones, did not undergo similar deterioration. Moreover, according to Dr. George Lechler, who is familiar with this icon, the art form is that of the seventeenth century. He believes it to be a copy of an earlier form.[1]

* The above-cited madonnas were not included in the original paper. Subsequent investigation revealed the existence of these representations of the Virgin.

The madonna at Czenstochowa is darker of skin than most Central European depictions of the Virgin. However, the figure is distinctly thirteenth to fourteenth century Byzantine in form, and this skin coloring is a characteristic feature of varied Byzantine portraiture. According to Ernst Scheyer, who studied this madonna at the behest of the Polish government, the present image was restored in the nineteenth century.[2] How the image got to Czenstochowa is debatable. Local legend describes a miraculous appearance of the statue sometime in the fifteenth or sixteenth century. For those who would rather explore the alternative possibility of diffusion, it may be noted parenthetically that the Queen of Poland *ca.* 1515 was Bona Sforza of Bari, Italy.

We wish to emphasize that all the black madonnas mentioned above are "miracle-working madonnas," and, with the exception of the Polish madonna, all these images are found in areas occupied by the Roman legions. The bulk of this paper is centered on the madonnas of southern Italy, but let us note some of the history and legend attached to other black madonnas listed above.

The statue of Our Lady of Montserrat was supposedly carved by St. Luke, in Jerusalem (La Jerosolimitana), and legend holds that it was brought to Barcelona by St. Peter. The statue was removed from Barcelona during the Moorish invasion of Catalonia in A.D. 718. Hidden in a cave near Montserrat, it was rediscovered in 880. Earliest archival notations indicate that the image was black at least as long ago as A.D. 718.

Our Lady of the Hermits at Einsiedeln, Switzerland, exhibits a history that may be traced back as far as A.D. 835. St. Meinrad built a chapel to the Virgin that year. Local tradition, however, alleges that the statue was brought there by Crusaders returning from the Middle East. This statue does not appear to be Byzantine in origin, nor does it give evidence of being a ninth century German art form.

The Black Virgin at Chartres dates back to the fourth century. Early Christian travelers to that area found an altar made by the Druids (?) upon which was seated a woman holding within her arms the figure of a child. This pagan image was black in color. The cathedral at Chartres, founded in the fourth century, was dedicated to the Virgin and Child. Although the present statue of the Virgin at Chartres is depicted as black, it is of more recent origin.

The Sanctuary of the Madonna of Tindari occupies the site of a fifteenth century church that had been built on the ruins of a temple to Cybele. This

Our Lady of the Hermits, the Madonna of Einsiedeln, Switzerland.

ancient temple was mentioned in the writings of Strabo and Pliny. Greek influence in Tindari dates back to the founding of the city by the elder Dionysius in 395 B.C., and the city was colonized by Peloponnesian exiles driven from their homeland by the Spartans. This black madonna at Tindari is perhaps the most famous of the Sicilian images of the Virgin.

Castrogiovanni, a corruption of the Arabic *Kasr-Janni*, was the ancient Castrum Ennae. The mountain, upon which the town is situated, was the principal seat of worship for Demeter-Ceres. Founded ca. 664 B.C. by the Syracusans, the town was considered a choice prize by the many invaders of Sicily during the course of history. A temple to Ceres and Proserpine built at the summit of the mountain was the object of pagan pilgrimages before the introduction of Christianity in the eleventh century. The present church, Madonna della Visitazione, built by Queen Eleanora in 1307, incorporates in its south wall a pillar from the old temple of Ceres. The current statue of the madonna was constructed in the mid-nineteenth century. This image of the Virgin is not black.

Ancient Enna was sacred to both Ceres and her daughter Proserpine. It was in this locale that the abduction of the daughter by Pluto took place. According to Greek mythology, Proserpine (Persephone) was called Saviour, having gone through death and resurrection. It is at Castrogiovanni that one finds the most interesting adaptations of pagan symbolism by the Catholic Church. Until mid-nineteenth century, the images of Ceres and Proserpine were used in the church as the Virgin and Infant Jesus, despite the fact that Proserpine was female![3]

One writer, William Paton, has this to say about the ritual connected with the Castrogiovanni madonna:[4]

> On the day of the fete of the "Madonna of all the Graces" her worshippers place before her statue large sheaves of grain and bunches of wild flowers, and form processions in her honor, composed of men in long white tunics, who carry flowers in their hands, make offerings of grain and other products of the soil before the altar in the churches . . . it seems most reasonable to believe that many of the old pagan rites have been preserved in their essential forms in Christian ceremonies of today. . . . it is safe to say that Christian priests have added little to that ritual [of Demeter], have taken little from it, and today religious ceremonies practised

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by the farming communities of Sicily are essentially the same as they were twenty-five centuries ago, with the exception that Christian saints have usurped the honors and dignities of pagan deities.

The history of the District of Apuglia shows frequent and prolonged culture contacts with the various groups that have occupied the Mediterranean basin. On this basis we look for indications of diffusion. The written record of Foggia Province begins around 975 B.C.[5] At that time one Diomedi, King of Etolia (a section of ancient Greece), landed at Rodi and journeyed to the Temple of Minerva at Lucera. There he remained, established a kingdom, married the daughter of the King of Daunia, and built a temple to Ceres (goddess of grain). Diomedi also built temples to Calcante (god of prophecy) and Podalirio (god of medicine) at Castel Drione, site of San Severo.

The region was occupied by the indigenous Italic tribes, the Pencezi and the Messapi. To the north were the Molise, in what is now the District of Abruzzi. According to the local legend this area was first visited by the Phoenicians as early as the tenth century B.C. Phoenician temples to Ma or Ammar were utilized by the Greeks, who rededicated these same temples to the Cretan Rhea or Cybele. Cybele, the mother goddess, gave birth to Demeter, the Greek goddess of grain, fertility, and earth. It is pertinent to our thesis that there were actually two Demeters. One was the sorrowful Eleusinian mother. The second and more powerful was Demeter Melaina, the Black Demeter associated with the earth and fertility.

The Greeks built temples to Demeter in and around the area of Foggia Province. Lucera existed as a city-state independent of Rome until 400 B.C.; then she allied herself with Rome and later (319 B.C.) became a colony of the Roman Empire. It was during this period that a cult of the Egyptian Isis was introduced into this area by seagoing natives of Apuglia. We should mention that Isis-Horus have been depicted as black by the Egyptians.

Many scholars have observed resemblances between the Osiris myth of death and resurrection and the story of Jesus. Carl G. Jung suggested that the wife of Osiris, Isis, and her son Horus may be considered as an Egyptian anticipation of the Virgin-child complex.[6] Direct contact between Hebrews and Egyptians is described in the story of Joseph, who may be regarded as a vizier under a Hyksos king, during the second Intermediate Period of Egypt.

It was Herodotus who suggested the connection between the Egyptian Isis and the Greek Demeter. While never explicitly acknowledged by the Romans, it seems evident that Ceres is a Roman adaptation of the Greek Demeter. At this point it should be stressed that the Roman Ceres was likewise depicted as black.

St. Peter, on his way to Rome in A.D. 42 installed Basso as the Bishop of Lucera. St. Basso built a cathedral to the Virgin Mary on the precise spot occupied by the Roman temple to Ceres. The cathedral was dedicated to the Madonna della Spiga (literally, sheaf of wheat, and later, ear of corn). After the fall of Rome this area was occupied by the Eruli, Ostrogoths, Greeks, Longobards, Moslems, Greeks (again), Normans, and the forces of the Holy Roman Empire, in that order. Frederick II (grandson of Frederick Barbarossa) invited the Moslems into the area in 1225 and built a mosque for them on the site of the Cathedral Madonna della Spiga. The Anjou dynasty, which came to power after the death of Frederick II, forced the Moslems from Lucera and rebuilt the mosque into the present-day Cathedral di San Francesco. The statue of the Virgin and Child was re-installed in the Cathedral in 1300.

Santa Maria, the Patron Saint of Lucera, is credited with the liberation of the city from the Moslems by Charles II (Carlo Secondo di'Anjou). A second major miracle attributed to the statue is the end of a plague of cholera on July 13, 1837. The statue miraculously moved its eyes on that date and for two consecutive days thereafter, bringing to an end the plague which had ravaged the city. If *dulia* and *hyperdulia* (veneration and adoration) are accorded saints, then the only word for the adoration of this image is that of *latria* (worship). The Madonna is worshipped for its power rather than the grace normally accorded the Virgin. It is showered with wheat, corn, and other sacrificial offerings on feast days, particularly on those feast days which coincide with the seasons of planting and harvesting. It is accorded powers relating to fertility (human, animal, and vegetative).

Elsewhere in southern Italy one finds other examples of these madonnas. The present-day church of Santa Maria di Siponto occupies the site of Sipontum, an ancient Roman colony. Because of flood threats, the city of Siponto was abandoned in A.D. 1256, and the inhabitants moved to Manfredonia two miles to the east. Records indicate that the present church was constructed prior to 1117. Before its reconstruction by Julius III in 1508, there are indications that the Saracens used the building as a mosque. The lower level of this church contains the tomb of Emilius Tullius (A.D.

593) and the miracle-working madonna. Local legends attest to the fertility powers of the icon. The origin of this statue is said to be Byzantine.[7]

At the summit of Monte Vergine, near Avellino, was the temple to Ceres in which the high priest Atys held sway as the Sybelenne oracle. The mountain draws its name from one Virgilius, a great necromancer and compounder of herb drugs (l'Orto di Virgilio). Christianity was late in coming to this stronghold of pagan beliefs. Henry Swinburne, the English author and traveler, claimed that the term "pagan" was a corruption of the word *pagi* (or *pagani*) meaning heathen inhabitants of the local villages.[8] In A.D. 1119 William of Vercelli dedicated the mountain to the Virgin Mary and founded a Benedictine abbey (the White Monks) on the site of the temple to Ceres. Swinburne acknowledged the tribulations of establishing Christianity in this area:[9]

> The missionaries sent among them to preach the faith of Christ found no means of conversion so easy and efficacious as those of admitting some of the names and ceremonies of the old church into the ritual of the new one. By thus adopting many tenets and forms of Paganism, they reconciled their proselytes to the idea of exchanging Jupiter for Jehovah, and their lares and penates for saints and guardian angels. To this expedient of priestcraft must be ascribed many strange devotions and local superstitions, still prevalent in Roman Catholic countries, which ought not to be confounded by the adversaries of that church with its real doctrines. All the truly learned and sensible persons of that communion reject, abhor, and lament such depravation; and, were it possible to reason rude minds out of hereditary prejudices, would long since have abolished them.

La Madonna di Constantinopoli (la Schiavona) is enshrined in the church, which contains four standing columns of *porta santa* marble that are part of the original temple to Ceres. This portrait of the Virgin is in two parts. The bust, carved of brown wood, is the work of Montano d'Arezzo and was completed about 1340. The head was brought from Constantinople by Catherine, wife of Philip d'Anjou, the titular emperor of that city. Legend holds that this painted head was the work of St. Luke in Antioch.[10] Swinburne takes issue with the legendary origin of the head:[11]

> This image is of gigantic or heroic proportion, and passes for the work of St. Luke the Evangelist, though the very size is an argument against its being a portrait from the life, had we even the slightest reason to believe he ever handled the pencil. There are in Italy and elsewhere some dozens of black, ugly Madonnas, which all pass for the work of his hands, and as such are revered.

The Black Madonna of Czenstochowa, Poland.

Swinburne goes on to explain that there was a painter in Constantinople called "Holy" Luke because of his piety and because of his exemplary life devoted to painting representations of the Virgin. His work was later attributed to St. Luke, since no one knew of another saint or painter by that name. Swinburne casts doubt on the idea that St. Luke was ever an artist.

Catholic sources, for the most part, have denied the possible connection between the black madonnas and the Roman Ceres. Nevertheless, it was St. Augustine who noted that the Virgin Mary represents the Earth and that Jesus is of the earth born. Archbishop John Hamilton in his *Scot's Catechism* (1552) states ". . . [these statues] darkened into something not far from idolatry . . . when . . . one image of the Virgin (generally a black or ugly one) was regarded . . . as more powerful for the help of suppliants. . . ."

A Mrs. Jameson, writing in the 1890's on the *Legends of the Madonna*, remarks:

> Because some of the Greek pictures and carved images have become black through extreme age, it

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> was argued by certain devout writers that the Virgin herself must have been of very dark complexion; and in favor of this idea, they quoted from the canticles, "I am black, but comely, O ye daughters of Jerusalem." [*sic*]* But others say her complexion became black only through her sojourn in Egypt. At all events, though the blackness of these antique images was supposed to enhance their sanctity, it has never been imitated in the fine arts. . . .

As we have previously noted, although some of the black madonnas are black because of age, this mechanistic dismissal fails to explain *all* the black madonnas. It is at this point that we suggest our hypothesis: The black madonnas are Christian borrowings from earlier pagan art forms which depicted Ceres, Demeter, or Isis as black in the color characteristic of these goddesses of the earth. Along this line, in 1335 a prior at the Chalis Monastery named Guillaume de Digulleville noted that Mary represents the earth, which is the body and darkness.[12] Hence, Mary being of the earth, can rightfully act as celestial attorney for all earthly sinners.

Experts on medieval art forms have demonstrated the influence of classical mythology on the paintings of the Middle Ages. It is entirely possible that medieval painters borrowed from classical mythology, dropped the original forms, and related them to the Virgin Mary.[13] However, in this paper we are concerned with some statues which seemingly predate the period of the Middle Ages. We are probably dealing with more direct forms of culture borrowing, possibly as part of direct culture contact.

Students of mythology have long pointed out that "black" could be regarded as associated with the earth. Carl G. Jung has equated "black" with the fertility powers of the earth, with the power of death, and with a fear of the power of darkness. Although we do not claim that any such necessary and inherent relationship would obtain in all parts of the earth, this association can be demonstrated easily for the cultures involved in our thesis.

We will reiterate that all the black madonnas are *powerful* madonnas, i.e., they are miracle workers. They are implored for intercession in the various problems of fertility. They are given *latria* rather than hyperdulia. Hence, we are equating their blackness with their power, which far exceeds that granted most madonnas in this sphere.

Anthropology is replete with examples of syncretism and reinterpretation as parts of the general process of acculturation. The development of Hinduism is one of the classic examples of syncretism in supernaturalism. Equally illustrative and analogous to our topic is the almost endless and intricate modification of various Egyptian deities in the early dynastic periods. When the capital of Egypt was moved to Thebes, Amon, who was the local god of the city, merged with Rē, the national sun god, to become Amon-Rē.† Changes in the culture of any society are always influenced by the pre-existing customs and institutions of that society. This is not to say that displacements never occur, or that innovations never obliterate older patterns of behavior.‡ For the most part, however, mankind is not easily detached from the patterned customs and beliefs which have fastened themselves securely upon human beings. The adoption of new beliefs is facilitated when the beliefs can be equated in some fashion with the older and compatible experiences.

It is in this light that we offer our hypothesis that these madonnas exemplify a reinterpretation of pagan customs, that they have functioned as aids in the preservation of continuity in the transition from pagan beliefs to Roman Catholicism.

* The canticles (*Song of Songs*) refers not to the Virgin but to a conversation between King Solomon and his black Queen. The intent of the original Hebrew version clearly sets forth the relationship between the two lovers.

† For a discussion of this kind of gradual modification of deities, see H. Frankfort *et al.*, *The Intellectual Adventure of Ancient Man* (Chicago: University of Chicago Press, 1946), pp. 31–121.

‡ A recent work discusses this process in detail. See L. S. B. Leakey, *Mau Mau and the Kikuyu* (London: Methuen Company, 1953), pp. 78–85, 112.

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Evolution of a Transportational Route as the Core of a Suburban Region

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SUBURBAN regions are commonly strung out along major arteries of transportation leading from a metropolis. In the vicinity of the transportational route the characteristics that distinguish the suburb are best displayed. This is the "core" of the region. As one progresses farther from this core, the distinguishing characteristics diminish in intensity and blend in with the features of the adjoining region. Often the interrelationships of the characteristics of two adjoining suburban regions are so intimate that great difficulty is encountered in determining a boundary line that will separate them. Thus the characteristics that give a region individuality are most prominent in its core. It is intended, here, to illustrate how a suburban region can develop a well-defined "heart" or "core" based upon the overwhelming presence of a transportational route. The sample region selected for analysis is a residential suburb of Philadelphia—The Main Line District (Fig. 1).*

Imagine a large wheel the hub of which represents the city of Philadelphia and the spokes of which depict the arteries of transportation leading out of the metropolis; it is then possible to visualize the principal features of transportation in the Main Line Suburban Region. The area lies along the meridian of the spoke extending due west from the central hub (Fig. 2). Transportation moves along this meridian in an east-west direction. Furthermore this spoke of transportation is rather efficiently isolated from the other "spokes" to the north and south; it is practically impossible to travel conveniently to adjacent suburban areas on public conveyances without first going through the central city to make connections.

This east-west trend of transportation has been conspicuous since the earliest settlements in the area, but its persistence is the result of two major developments. First, the Main Line District has become in reality a residential "bedroom." It is comparable to a dormitory; people live there but depend upon the city for employment, shopping, pleasure, education, and the other conveniences offered by a large metropolis. This intimate relationship generates a daily stream of commuters. The second reason is that the Main Line District lies along one of the principal east-west continental routes, which creates additional heavy through traffic.

Early Routes of Transportation

Since the earliest days of recorded history in the region east-west transportation has been of prime importance to the area now known as the Main Line. At first the Indians had a trail leading from the Delaware River to the Conestoga River and thence to the Susquehanna. At that time the trail was referred to as the Kitanning Path.[1] Soon after William Penn and the colonists appeared, this trail became a bridle path. People traveled on horseback, and freight moved by pack train. The twenty-five or so miles at the eastern end of this trail lay within the original Welsh "Barony" (now known as the Main Line District). To reach this westward trail it was necessary to cross the Schuylkill

* For a detailed account of the determination of the boundaries of the Main Line Suburban Region see "Delimiting the Main Line District of Philadelphia," by George Langdon, *Economic Geography,* pp. 57–65, January, 1952.

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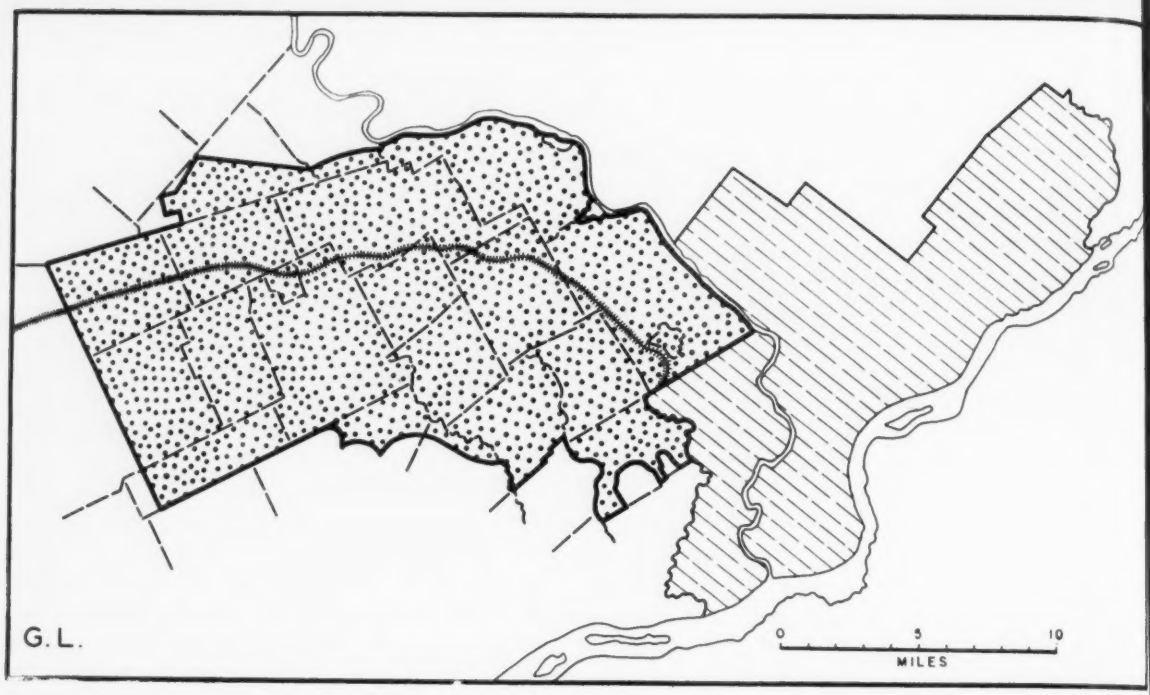

FIG. 1. The extent of the Philadelphia Main Line Suburban Region is shown by the dots superimposed upon the presently existing township lines. The line bisecting the Main Line area is the route of the Pennsylvania Railroad and illustrates the east-west trend of the transportational meridian. The area of diagonal lines represents the city of Philadelphia.

River, and, until ferry service was provided in 1682, it was difficult of access.[2]

In addition to this route to the west the residents made great use of the natural thoroughfare offered by the Schuylkill River. It flowed conveniently along the northern edges of their tract directly to the great, growing town of Philadelphia on the Delaware (Fig. 3).

The Old Lancaster or Conestoga Road

Within thirty years there was a road, of a sort, extending between Philadelphia and the Dutch settlements on the Conestoga River. It rather closely followed the old Indian trail. The portion between Philadelphia and the Welsh settlements west of the Schuylkill was laid out as early as 1690; it was one of the oldest roads on the continent. Efforts were made from time to time to open regular stage service, but the ruts, the mire, the snow, and the dust were victorious, and all attempts were futile.

In spite of these difficulties the Old Lancaster Road was a busy route to the interior. Traffic increased steadily, and there was great demand for a more commodious passage westward. Picturesque wayside inns began to appear along the route, and the pack trains were gradually replaced by the

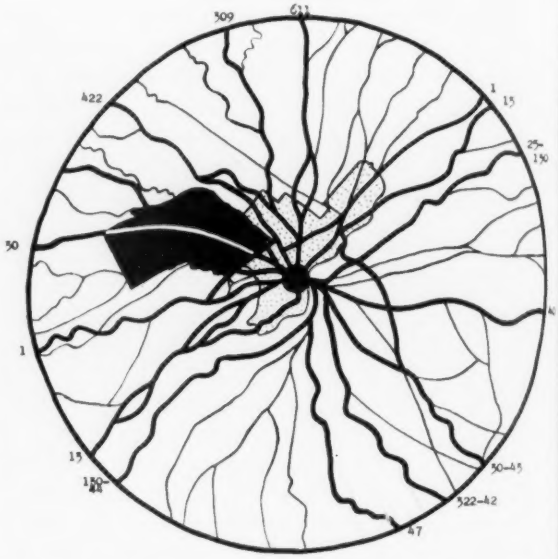

FIG. 2. The hub of the huge wheel of transportation around Philadelphia is indicated by the black circle in the commercial center of the city. The extent of the city is shown by the dots. Heavy lines represent the leading highways and thin lines the less important routes leading out of the city. The darkened area west of the city is the Main Line Suburban Region. The white line bisecting the area shows the location of the principal east-west route, the Lincoln Highway (U.S. 30) and the Pennsylvania Railroad's main line tracks. Numbers indicate the principal routes.

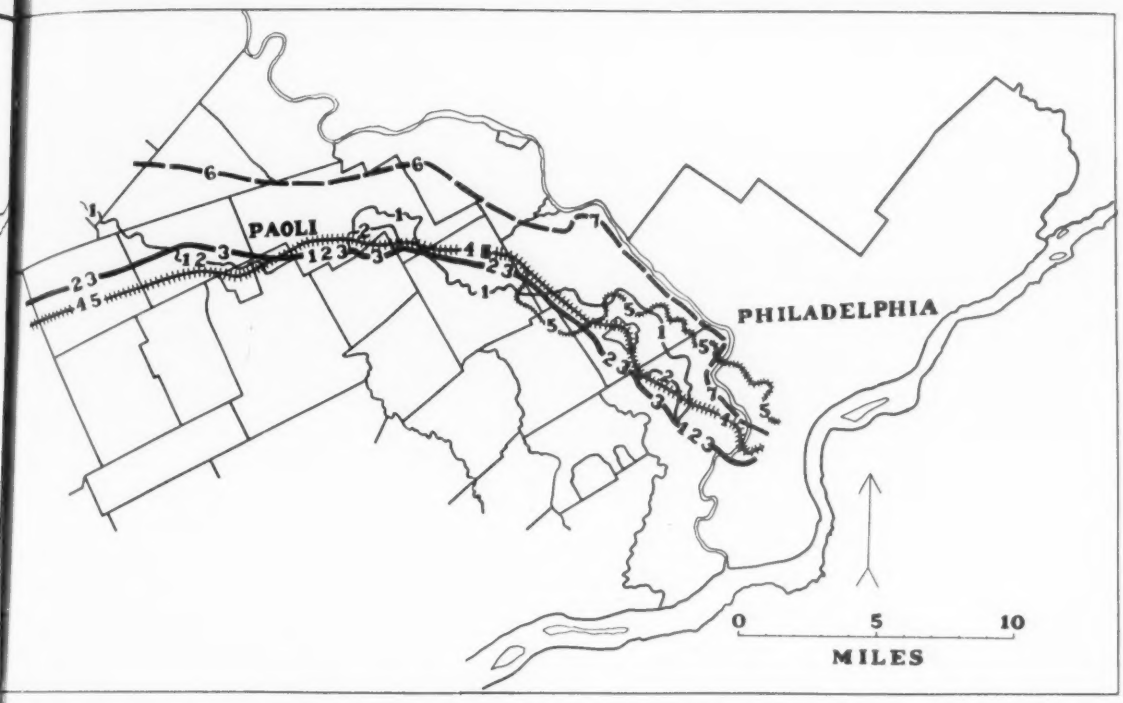

FIG. 3. Comparative approximate locations of the historical routes of transportation in the Philadelphia Main Line Suburban Region. The general east-west trend of the transportational meridian is evident. The routes are superposed upon the existing township structure. The historical routes referred to in the text are numbered on the map as follows: (1) Old Lancaster or Conestoga Road, (2) Lancaster Turnpike, (3) Lincoln Highway, (4) The Pennsylvania Railroad's main line tracks, (5) Old Philadelphia and Columbia Railroad, (6) approximate location of the Pennsylvania Turnpike, (7) approximate proposed route of the Schuylkill Expressway.

famous Conestoga Wagons. In fact, these freighters became so popular along the route that the Old Lancaster Road was often called "The Great Conestoga Road" (Fig. 3). Portions of this road exist to this day and are still known by that name.

The Lancaster Turnpike

In 1791 the legislature authorized the construction of a new turnpike to Lancaster. The turnpike was completed in 1794.* It was 50 feet wide and over 62 miles in length; there was a center, paved with crushed stone, 24 feet wide and 18 inches deep. It was the first road of its kind in the country, and tolls were charged travelers making use of the route. Traffic increased greatly, and the turnpike was more than financially successful. This success inspired the construction of thousands of additional miles of turnpike roads throughout the country patterned after the Lancaster model. Unfortunately, because of the sudden introduction of steam power, most of these turnpikes were utter failures.

The new Lancaster Turnpike became congested with an almost unbroken procession of the ponderous Conestoga Wagons, regularly scheduled stagecoaches, large herds of animals being driven to market, and picturesque farmers' wagons. Travel was so extensive along this route that it was without parallel in the history of the country prior to the introduction of steam power.[3] Use of the turnpike increased apace until the 1830's; its period of usefulness was indeed the era of travel by wagon.

The famous Conestoga Wagons attained their greatest prominence along the route of this turnpike, and by the time of the War of 1812 they were in very general use. The wagons were well designed for the carrying of freight, because they had a curved bottom that prevented the cargo from slipping back and forth, and broad-rimmed wheels that prevented them from sinking into soft ground.

The Philadelphia and Columbia Railroad

In 1825 the State of New York very successfully initiated the canal-building period with the construction of the Erie Canal. Increasingly, westward traffic was moving along this new route to the interior. Philadelphia was then the largest city

* Some sources say it was authorized in 1792 and completed in 1796.

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in the country, but it was losing traffic to the more rapidly developing New York metropolis. Pennsylvania decided that something must be done to stop this loss. The solution was an interlocking system of canals, inclined planes, and railroads from Philadelphia to Pittsburgh. The Philadelphia and Columbia Railroad made up the easternmost 82 miles of this route.

Laid out in 1828 and completed in 1834, the railroad followed the general east-west trend of the Turnpike as illustrated in Figure 3. The completion of the railroad was the beginning of the end for the Turnpike. Parts of it were even abandoned as parts of the Old Conestoga Road had been abandoned with the opening of the Turnpike.

The Columbia Railroad consisted of a single track (at first) of wooden rails firmly bolted to stone blocks. Crushed stone filled the space between the rails to provide a footing for horses used to pull the cars. Many curves were introduced solely to placate farmers, who either wished, or did not wish, to have the railroad near them.

In 1834 the first steam locomotive, known as the "Black Hawk," passed over the road. For a time attempts were made to use both horses and locomotives; another track was laid to provide one for horses and one for locomotives, but the experiment was a complete failure. Horsepower fought a losing battle, and by 1840 only locomotives were in use.

Although the Columbia Railroad augmented travel through this area, the complicated system of water and land routes to the west proved to be poor competition for the Erie Canal. By 1840 Philadelphia had lost the distinction of being the nation's largest city. It never regained that title.

Early Days of the Pennsylvania Railroad Company

The Pennsylvania Railroad Company was organized in 1846 to eliminate the disadvantages of the complicated rail-canal-inclined plane route over the mountains to the west. Within a few short years this through route became the "main line" for the exchange of commerce between east and west. It was during these years of successful expansion that the term "Main Line" was applied to the area along the tracks near western Philadelphia.

The era was heralded by improvements. The Old Columbia Railroad was straightened, particularly between the city terminal and the vicinity of Bryn Mawr (Fig. 3). The old inclined planes along the steep banks of the Schuylkill were replaced by gentle grades.

Westward, beyond Bryn Mawr, the Pennsylvania Railroad followed, as a rule, the old roadbed (Fig. 3). This portion of the track was not altered nearly so much as the portion closer to the city. Also, in the western end of the area, the terminal facilities of Paoli were further developed. Rail yards were enlarged to alleviate the congestion of local commuter trains ending their runs there. Before these improvements, it usually took over two hours to get from Paoli to the city.

In the 1860's the Pennsylvania Railroad did not cater greatly to commuters. Most of the residents of the "Main Line" were farmers, and they required six trains a day each way, and none on Sundays. The picturesque trains were drawn by queer, puffing locomotives with large cowcatchers; the cars had oil lamps for light and coal stoves for heat. By 1875 traffic had increased so much that the Pennsylvania Railroad bragged of its total of sixty-two regular passenger trains entering and leaving the old West Philadelphia Station every twenty-four hours. In those days this was indeed an accomplishment.

During these early years the need for through service from New York City became increasingly apparent. By 1871 Jersey City, New Jersey, had replaced Philadelphia as the eastern terminus with ferry service to New York. It wasn't until 1910, however, that tunnels under the Hudson provided facilities for riding directly into New York City. The railroad also expanded westward to Chicago and St. Louis. These developments had a profound influence on Philadelphia's Main Line District. They became the basis for the through east-west traffic so characteristic of transportation within the core of this region.

Development after the Early 1900's

Although the relatively high elevation made the Main Line area cooler than the city and enticed many Philadelphians to spend summers at "hotels" and "boardinghouses," not until transportational facilities were improved did people consider establishing themselves as permanent residents. Many early immigrants from the congested city were officials, directors, financiers, and industrialists closely affiliated with the railroad. They used their influence in demanding rapid improvements in commuter service. Within a few years the section was given one of the best suburban railroad services in the world. After these changes the Main Line District experienced major influxes of resident population.

One of the most significant advancements to

influence the geographic background of the Main Line area was the introduction of electrically operated trains. Noisy, smoky steam locomotives were replaced by quiet, clean electric locomotives. Trains passing through no longer belched smoke and dirt.

Then a bypassing route was constructed just to the west of the Main Line District. This route, also electrified, was called the "Trenton-Cutoff," and it followed the Chester Valley to the north of the "main route." It rejoined the main tracks near Trenton, New Jersey. The existence of this bypassing route meant that only a relatively few noisy freight trains passed through the Main Line, and dirt, noise, and congestion were minimized in the core of the Main Line Suburban Region.

Electrically operated express trains speed through the Main Line area without stopping until they get to terminal Paoli. The powerful locomotives pulling such trains are 79½ feet long, weigh 460,000 pounds, and develop 4620 horsepower.

To a resident of the Main Line the commuter train is more familiar and vital. It is called "The Paoli Local," and, in striking contrast to the express trains, it jerks along the track, stopping and starting at 18 stations in 20 miles (Table 1). It has a queer honking whistle announcing its departure, and it hardly ever attains full speed before it is time to start braking for the next station.

TABLE 1

COMMUTER STOP CHARACTERISTICS ALONG THE MAIN LINE*

Miles from Philadelphia	Names of Station Stops on the Main Line	Total Number of Trains Stopping Daily
0.0	Philadelphia (all stations)	139†
4.1	52nd Street	58‡
5.6	Overbrook (City Line)	77
6.1	Merion	75
7.0	Narberth	79
7.6	Wynnewood	78
8.6	Ardmore	84
9.3	Haverford	85
10.3	Bryn Mawr	85
11.0	Rosemont	82
12.1	Villanova	83
13.1	Radnor	84
13.9	St. Davids	84
14.6	Wayne	85
15.5	Strafford	83
16.6	Devon	86
17.7	Berwyn	86
18.7	Daylesford	70§
20.0	Paoli	139

* Information from timetables of the Pennsylvania Railroad made effective March 2, 1947. These statistics include only trains operating at least 5 days per week.

† This figure (139) includes only those trains that run along the Main Line District. There is a grand total of over 600 trains in and out of Philadelphia daily.

‡ The figure 58 includes only trains originating or terminating at Paoli; other trains from Chestnut Hill, etc., stop here too. The daily total is 89 trains.

§ Most trains stop here only on signal to receive or discharge passengers.

Characteristics of Present-Day Commuter Service

Examination of Table 1 reveals several important developments. First, the Pennsylvania Railroad attempts to provide most frequent and efficient service to station stops lying some distance outside the city limits. Stations close to central city have fewer trains stopping daily, and many of them are expresses to the central city terminal. For example, the 52nd Street Station has only 58 inbound and outbound trains daily. Even Overbrook, which is at the city line, has only 77 trains. Farther out, beyond Ardmore (8.6 miles from central city), some station stops have as many as 86 inbound and outbound trains daily. Second, the commuter stops are closer together farther out on the route. There is only one stop (52nd Street) in the 5.6 miles between city line (Overbrook Station) and central city. Farther out, some of the stops are only 0.6 mile apart. It is apparent that commuters in or near the city depend more upon local bus and trolley service.

The stops at Overbrook (city line, 5.6 miles out), Merion (6.1 miles out), Narberth (7.0 miles out), and Ardmore (8.6 miles out) are more than significant because trains often operate as expresses to and from these points. For example, an outbound train is classified as an express as far as one of these stops and then becomes a "local" or a "skip-stop express" farther out. Inbound, the situation is similar, no stops being made between these stations and the central city terminal. Excluding the early morning hours, the average main line station has a total of one train in each direction every half an hour. During the "rush hours" trains may run only a few minutes apart. Most express trains and those that skip stops are operated during these "rush hours."

The terminal function of Paoli is apparent. A total of 139 trains stop there daily (Table 1). Fifty-three of them are through passenger trains. The other eighty-six are "locals" (74) and "skip-stop expresses" (12) to the city. Often the residents of the area take the "Paoli Local" to Paoli, where they can conveniently make connections with any through train and thus avoid the congestion of mid-city. The fact that all trains stop at terminal Paoli offers an additional advantage to commuters residing near there, 20 miles from Philadelphia. They can get into the city in less than 24 minutes on an "express" (Table 2).

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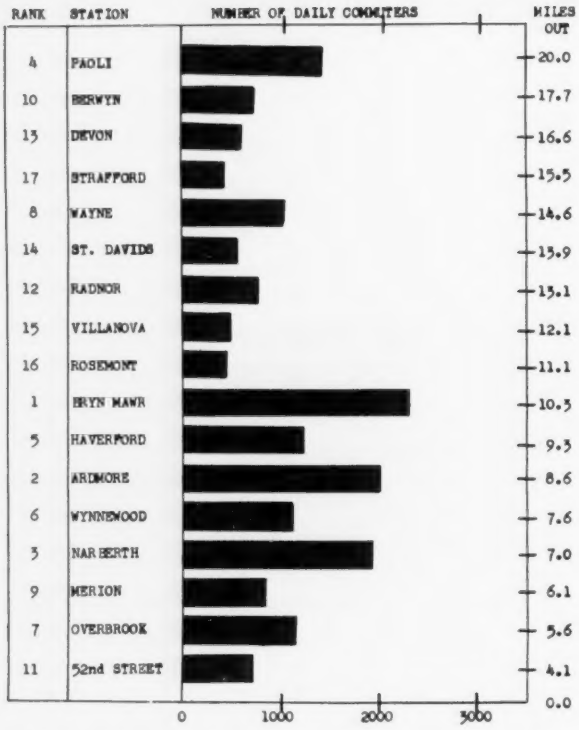

FIG. 4. Relative importance of the commuter stations according to the number of daily commuters utilizing each station stop.

Curtailed service to points in and near the city and extra service to points farther out make it possible to get to some parts of the Main Line District in a shorter period of time than it takes to get to outlying parts of the city proper by local bus and trolley service. For example, it takes about 17 minutes by the "local," 15 minutes by a "skip-stop express," and 12 minutes by an "express" to get to Ardmore, 8.6 miles from central city (Table 2).

Distribution of Commuters

To get an accurate picture of the distribution of commuters along the route of the "Paoli Local" it is necessary to compare Figures 4 and 5. The bar graph in Figure 4 illustrates the relative importance of commuter stations according to the number of daily commuters utilizing the stop. The graph is based on the number of daily passengers. The three most important stops along the main line are Bryn Mawr (2240 daily commuters), Ardmore (1950), and Narberth (1885). Paoli is in fourth place (1650), remaining important despite the great distance (20 miles) from the city because of its terminal function. The figures on the right vertical scale indicate the number of miles each stop is from the Philadelphia terminal. The most important station stops lie within the 3.3 miles between Narberth and Bryn Mawr. The only significant exception is Paoli. The least important station is a flag stop at Daylesford (18.7 miles out). It does not appear on the graph. The least important station with regularly scheduled stops is Strafford (320 daily passengers).

Figure 5 is a line graph showing the approximate volume of daily commuters passing through each station. The vertical scale indicates the relative distance between stops. The numbers show how many miles each station is from the Philadelphia terminal. The horizontal scale shows the number of daily commuters on the trains as they pass through each station. The line of the graph corresponds to the cumulative total. To get these figures it was necessary to add the number of daily commuters from each stop to the total number of passengers already on the trains.

The most significant characteristic of commutation brought out by Figure 5 is the location and distance from the city of the points at which most commuters board the trains. A significant number (about 1650) of the passengers originate at the Paoli terminus for the daily round trip to Philadelphia. Many others arrive at and depart from Paoli on express trains, some of them taking the "local" to some community down the "line." Although about 1650 commuters begin the daily trip at Paoli, relatively few passengers board the trains in the first 9 miles inbound. At Rosemont (11 miles from the city) the cumulative total has risen to only 5855 passengers. The figure quickly jumps to 8095 passengers at the next station, Bryn Mawr. From here on the increase is great at each stop to the city line at Overbrook Station. The cumulative total rises to over 16,360 daily com-

TABLE 2

RUNNING TIME OF COMMUTER TRAINS TO SELECTED STATIONS*

Miles from Philadelphia	Selected Stations on the "Main Line"	Time by Express, No Stops	Time by Skip-Stop Express	Time by Local, All Stops
5.6	Overbrook	8 minutes	—	9 minutes
7.0	Narberth	10 minutes	11 minutes	13 minutes
8.6	Ardmore	12 minutes	15 minutes	17 minutes
10.3	Bryn Mawr	—	17 minutes	21 minutes
14.6	Wayne	—	24 minutes	30 minutes
17.7	Berwyn	—	31 minutes	37 minutes
20.0	Paoli	24 minutes	36 minutes	41 minutes

* Time is computed to 30th Street Station (Pennsylvania Station). Add about 3 minutes for Broad Street Suburban Station. The stated times are approximate; some trains are a few minutes faster, others a few minutes slower. Information from timetables of the Pennsylvania Railroad made effective March 2, 1947.

muters at the 52nd Street Station, 4.1 miles from the central city terminal. It is evident that the greatest number of commuters boards the trains between Overbrook (City Line Avenue, 5.6 miles out) and Bryn Mawr (10.3 miles out). This is also noticeable when one rides the trains. Inbound trains often have only standing room for passengers boarding at stops near the city. Outbound trains are similarly crowded for the first few miles and then become noticeably "empty" beyond Bryn Mawr.

It must be understood that the "cumulative total" upon which Figure 5 is based is merely an estimate and does not include people riding *through* the area on express trains nor passengers who ride *between stops* within the Main Line District itself. Although no figures were available for Daylesford, it is listed because there is no doubt that it is the least important stop on the route.

Bus and Trolley Routes

Local electric trolley and motor bus services supplement the facilities of the Pennsylvania Railroad. Typical is the Philadelphia and Western Railway Company. This rapid-transit trolley line leads westward from the 69th Street Terminal, which is the end-of-the-line for the subway-elevated routes leading out of central Philadelphia. Its route almost parallels that of the Pennsylvania Railroad, and, in places, the two tracks are within sight of each other.

It is possible to visualize the importance of such service when one considers that a typical station stop like Villanova has a total of 118 inbound and 116 outbound trolleys daily.

Development of the Lincoln Highway

After the abandonment of the Lancaster Turnpike and the advent of the railroad, the people who had settled along the main line became thoroughly disgusted with the sadly neglected Turnpike. Furthermore the route offered by the Old Lancaster Road became a menace to the interests of the paralleling Pennsylvania Railroad. The railroad feared that street car lines would be extended from the city into the growing suburbs and cut into its local passenger business. Therefore, to protect itself from such opposition and at the same time to improve the deplorable conditions on the pike, it formed a subsidiary company, the Lancaster Avenue Improvement Company, to take over the road.

This company purchased the portion of the road extending from 52nd Street to Paoli. Its improvement and maintenance were supported by tolls. The portion in Montgomery County, renamed Montgomery Avenue, became the first macadamized road in the United States. Farther west the road was called Lancaster Avenue, a name it still retains in places.[4] In the early 1910's this stretch became a part of the famous transcontinental Lincoln Highway, which, by 1923, was considered the "Main Street" of the nation.

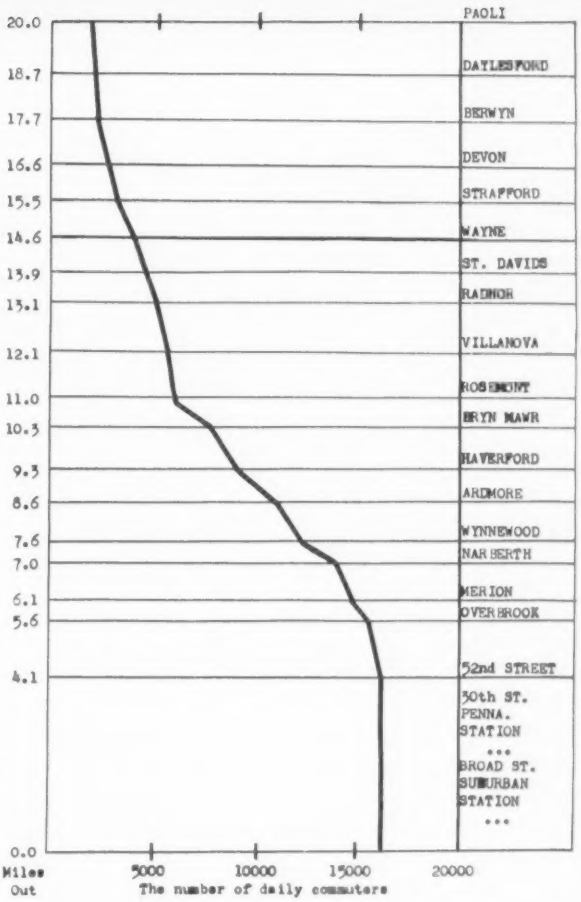

FIG. 5. The approximate volume of daily commuters passing through each station.

The development of the automobile led to the purchase of the route by the State Highway Department in 1917; this brought the end of tolls. By 1925 demands for an improved route were so great that the right-of-way was resurfaced, straightened, and widened. To accomplish this it was often necessary to shift sidewalks and slice properties. As a result sidewalks are very narrow and residences are but a few feet from the edge of the thoroughfare in many places in the core of the region today.

The present Lincoln Highway practically parallels the main line of the Pennsylvania Railroad,

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as indicated in Figure 3. It is a well-paved four-lane highway. Its development was of great significance to the characteristics of the core of the Main Line District. It brought tourists, hotel keepers, garages, service stations, restaurants and made it more convenient for the commuter to live farther from a railroad station.

An observer along this highway today would be impressed by the heavy volume of traffic. During the daylight hours the passenger automobile is in prominence, but at night the heavy trailer trucks roll and rumble continuously. Trucks are prohibited on many paralleling routes, which are reserved for the faster passenger vehicles. The most important of these passenger routes is Montgomery Avenue. This situation is similar to that of the Trenton-Cutoff, that is, the objectionable freight traffic, by truck as well as by locomotive, is diverted over selected routes and the value of certain residential areas is enhanced.

Relationship of Urban and Rural Development to the Transportational Meridian

The "urban" portion of the Philadelphia Main Line District is roughly a triangular area bisected by the main east-west transportation route. The base of the triangle lies along the several miles of the western Philadelphia city limits, while the apex of the triangle extends to a point near the community of Paoli, 20 miles from central city. The remaining portions of the Main Line District are, generally, rural, and they lie farther away from the transportational meridian. With distance westward within the "urban" area, large tracts of "rural" country are wedged between the small towns. Beyond Paoli most of the countryside is of a rural nature. Within this triangular area lying along the east-west transportational meridian the distinguishing characteristics of the core of the Philadelphia Main Line Suburban Region are best displayed.

FIG. 6. A typical "gateway" leading into a hidden estate in the Main Line Suburban Region. The roadway characteristically leads uphill because many country homes are located on hilltops.

It is difficult to determine whether the residents of the Main Line are really "urban" or "rural." Perhaps it is safe to say that they are urbanites living in a rural area. As Wehrwein would probably say, they are living in the area of transition between well-recognized urban land use and that area devoted to agriculture, or in "the rural-urban fringe."

The most characteristic feature of the rural portions of the Main Line District is its park-like appearance. A ride along one of the many meandering hard-surfaced roads reveals stately trees, spacious lawns, well-kept fences, and the country estates of gentlemen farmers. "The large size of the houses and the beauty of the yards and grounds are out of proportion to the associated farming operations. The emphasis is upon the establishment of attractive homes, not upon making a living from agriculture."[5]

The traveler is often disappointed because many of the estates were planned for the purpose of providing complete privacy. From the road the "gateway" may be the only indication of the presence of a residence. The typical gateway is quite elaborate, and from it a roadway usually leads up to the hidden estate (Fig. 6). The paved road usually leads up because frequently the country estate is situated on the top of a hill. The inhabitants are obviously city commuters, not farmers.

Within the last few decades the tendency has been to break up the large land holdings into small building lots. The "rural country farms" and "estates" that were wedged between the "towns" have gradually become less prominent. Building lots were thus provided near transportational facilities in beautiful regions where the comforts of a rural home were available. Relatively modest homes (in comparison to the older estates) appeared.

Today it is no longer necessary for a town to be clustered about the commuter station. "Motor transport has released man from the necessity of living in places where mass transportation is available."[6] This development has made it possible for commuters to live farther from the transportational meridian. They can drive to the local station and park the car there all day. Always, however, access to the main east-west transportational route is all-important to the resident of the Main Line District.

Perhaps the difficulty of parking in mid-city and the fatigue caused by actual driving are sufficient reasons for leaving the family car out along the main line. The train ride offers an opportunity to read the newspaper and relax. This tendency to leave cars parked in stations has increased. The railroad has recognized this trend and has provided ample parking space for its patrons. Figure 7 shows a typical Main Line Station stop. The striking architectural design is found in most stations of the district.

One of the most recent urban developments has been the construction of large, beautiful apartment houses, particularly in the built-up area closest to the city. This is the climax of the trend to reduce the size of the household from the typical old estate with spacious acres to a small apartment with a few bushes or a windowbox for a landscape. Thousands of "Mainliners" today live in these apartment houses rather than in great rambling mansions. Figure 8 illustrates the typical suburban apartment house.

Relationship Between Industrial Development and Transportational Facilities

One of the outstanding characteristics of the core of the Philadelphia Main Line Region is the scarcity of industrial development. This lack of industry exists despite the fact that the region lies along a major artery of transportation where it would be possible to import raw materials and export finished products conveniently. The Main Line Suburban District has developed as an almost entirely residential area. Transportational facilities have been aimed at serving the commuter. There is a pronounced lack of sidings and other facilities needed by industrial plants.

It is rather remarkable that this area has had such a limited development of industry when one considers that it is surrounded by great industrial regions. Still more unusual is the fact that these surrounding industrial regions give relatively little employment to "Mainliners." In general, they ignore nearby areas; few residents of the Main Line are employed in industry. Instead, they are mainly businessmen, professional people, managers, officials, clerical workers, and the like employed in central city Philadelphia. The evolution of the transportational route here has certainly not fostered industry.

Influence of the Pennsylvania Turnpike

The latest influence brought to bear upon the Philadelphia Main Line District is the location of

Fig. 7. The Haverford Station on a sunny afternoon between trains. Note the parking facilities.

the route of the recently constructed Pennsylvania Turnpike. Because this highway tends to avoid all areas of congestion, it does not follow the old transportational meridian that forms the core of this suburban region. Instead, it approaches the Main Line District from the northwest and terminates in the vicinity of the community of King of Prussia within the area studied (Fig. 3).

An arterial highway is to be constructed (construction has already begun) from King of Prussia along the Schuylkill River Valley into the city of Philadelphia. Ironically enough, this route roughly follows one of the first passageways used by early pioneers in the area when they navigated the Schuylkill for transportation. Although the new highway does not pass through the congested core of the Main Line District, it continues to follow the persistent east-west trend of transportation. The route of the new Pennsylvania Turnpike reminds one of the Trenton-Cutoff of the Pennsylvania Railroad for, as it cuts through the hills and mountains of the state, it bypasses the congested areas of the towns and cities in the core of the region.

Fig. 8. An apartment house at Wynnewood along the Lincoln Highway in the Main Line District.

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Summary and Suggestions

"This through route . . . exemplifies the evolution of transportation from Indian Path to pack horse trail, crude freight wagon road, stage coach turnpike, railroad and modern highway, probably better than any other single thorofare in the country today."[7] All the succeeding historical routes have, in general, followed the dominant east-west trend and have been the basis for developing the distinguishing characteristics of the core of the Philadelphia Main Line Suburban Region. Because all large cities have similar residential areas stretched along the major arteries of transportation, it is hoped that this study will inspire the continuation of research on the suburban fringe of metropolitan centers. All too often major study and emphasis are given to the political city or to the metropolitan area as a whole, and seldom are the specific characteristics of the city's suburbs considered. It is this type of overlooked area this study intends to describe.

It is suggested that studies be made of the evolution and distinguishing characteristics of the cores of other types of suburban districts. For example, in recent years there has been a tendency for industry to "decentralize" and move out of central city locations to the suburbs along some convenient transportation route. Certainly an industrial suburb would show a type of evolution different from the one portrayed here for a residential suburb located along a transportational route, and would result in the appearance of different distinguishing characteristics in its core. And what about the difference between the characteristics of the core of a suburban region with a dominantly educational function and those of a suburban area developing a commercial function with the construction of a modern shopping center in its midst? Here is a field of investigation that has been much neglected.

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THE HILLS

The hills roll wide on every side
Like waves upon the sea,
Breakers of granite tossed through time,
Surf of eternity.

The heaving hills in dumb show shout
Of days when time began,
When earth was an unsteady star
And like quicksilver ran.

James Dillet Freeman

Lee's Summit, Missouri

What Scientists Look for in Their Jobs

THERESA R. SHAPIRO

The author received her training at Hunter College and Columbia University and has held a wide variety of government posts in the field of labor economics. This article is one of a group of studies conducted for the U. S. Bureau of Labor Statistics as part of its continuing program of studies of scientific personnel.

IN this period of personnel shortages in the sciences, when the rate of turnover among scientific personnel is unusually high, it is pertinent to inquire what it is that scientists ask of a job. Employers who need to attract and retain competent scientists have the most obvious interest in the answer to this inquiry, but it is of concern also to scientists themselves. Young scientists, in particular, who are at an early stage of their careers, must make what may prove to be critical decisions as to where to work. On what basis should they choose among the many offers they are likely to receive? Should they seek the highest salary, the greatest promise of security, the most interesting work? Which will in the long run contribute the most to a satisfactory working life? Some light is thrown on these questions by a study of job satisfactions and dissatisfactions among scientists, carried out by the Bureau of Labor Statistics of the United States Department of Labor, as part of its program of studies of scientific personnel.

It should be said at the outset that any study of employees' attitudes toward their jobs which, like this one and almost all others, is based on interviews has certain inherent limitations. For one thing, pleasure or displeasure in a job situation is usually the result of several interrelated factors. The particular factor a person happens to mention to an interviewer months or years later may actually have been of secondary importance in the bygone situation. Moreover, people are not always aware of all the factors influencing their decisions to accept or leave a position, and they tend to ignore those outside the recognized and socially acceptable categories of values. Even when an interviewee remembers and understands his motivations, there is danger that he will not transmit them to the interviewer. Confronted by a strange face, no matter how sympathetic, most of us find it easier to retreat into stereotyped phrases or vague generalities than to talk frankly.

The story of Mr. Brown, a chemist, illustrates these points. Mr. Brown worked as a research chemist under the supervision of Mr. P., whom he liked and respected. One day Mr. P. left the company. Mr. Brown, who had hopes of inheriting Mr. P.'s position, found Mr. P.'s successor uncongenial and the supervision he exercised chafing. His salary seemed inadequate, now it was clear that it would not be raised. His work began to appear trivial and dull. For the next six months, however, Mr. Brown did nothing about all this except grumble to his wife. Then, one day, he ran into a former classmate, Mr. K. Always an optimistic fellow, Mr. K. was very enthusiastic about his job, his firm, and his colleagues. He knew of an opening and suggested that Mr. Brown apply for it. They made an appointment. Mr. K. introduced Mr. Brown, not only to the chief but also to several other men. The chief reminded Mr. Brown of his old boss, Mr. P., and the other men seemed very friendly. When Mr. Brown was offered a job with the ABC Company, at an increase of only $300 a year, he was delighted to accept.

Why did Mr. Brown become so dissatisfied with his job that he moved over to the ABC Company? The explanation he gave the interviewer was that he considered Mr. P.'s successor inferior and that he wanted more money. Reading between the lines, we are inclined to believe that it was the disappointment of Mr. Brown's hopes for a promotion and his chance meeting with his old classmate which were most responsible for his transfer.

If, then, interviews cannot be relied on for a complete and an objectively accurate analysis of the reasons why people like a given job, of what value are they in studying job satisfactions? The answer is that they furnish information as to employees'

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conscious motivations, particularly those that conform to the attitudes held in common by the group to which the workers belong. Since these attitudes have a decided influence on behavior, information concerning them is valuable to employers, personnel workers, and scientists themselves.

The insight into job satisfactions and dissatisfactions obtained through interviews is greatest when the group studied is homogeneous and cohesive. Scientists with Ph.D.'s, the subject of the present study, are such a group. They are knit together by a common background of training, often in the same schools, by membership in the same scientific societies, by a community of interest in science, and by many personal and professional relationships.

How the Study Was Conducted

This study is based on interviews conducted between December 1950 and June 1951 with 407 men physicists, biologists, and chemists, all of whom held doctorates. The interviews were arranged through the cooperation of various private firms, government agencies, and colleges and universities located on the eastern seaboard from New York City south to the District of Columbia. Some additional scientists were interviewed at the 1950 meeting of the AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, in Cleveland.*

Each scientist was asked to report his employment history from January 1, 1939, to the date of the interview. During this period, the 407 men in the study had made 574 job shifts, apart from those due to service in the Armed Forces. Since some of the men were still in college in 1939, the number of job entrances reported was greater (670) than the number of job exits (574). The average number of job entrances per scientist was 1.6, of exits 1.4. Most of the job shifts occurred while the scientists were still young; 85 per cent of the exits were made before their fortieth birthdays.

The approach used to determine the attitudes of these scientists toward their jobs was to inquire about the reasons for their job decisions. Each scientist who had changed employers since January 1939 was asked why he had left the jobs involved and why he had favored one offer over another in accepting a new position. Those who had not changed jobs since January 1, 1942, were asked why they had remained on the same jobs. It can be argued that these questions are an indirect way of studying job satisfactions. They have the value, however, of focusing on concrete situations and on attitudes which are, in a broad sense, operational.

The men were encouraged to talk freely, and the replies were coded after the interviews were completed. In most cases, the scientists felt that no one factor determined a particular decision. Some recalled as many as five different aspects of a job situation which had played some part in their decision to remain or to leave. In order to prevent the more talkative men from unduly influencing the statistical results, no more than three reasons were recorded or tabulated in connection with any job entrance or exit or for any scientist who had not changed positions.

Involuntary Job Shifts

The decision to stay on a job or leave it, as well as where to work, generally lay with the scientists themselves. Only 18 of the 155 scientists who had remained on their jobs for at least 8 years reported that they had had no other offer or none worth considering during this period. Only 67 of the 574 job exits were due to factors over which the scientists had no control, and 28 of these resulted from the termination of war projects. Furthermore, the scientists were rarely forced to accept a job for lack of another offer; this was the case for only 5% of the 670 job entrances covered by the study. Very likely, the fact that the scientists were able to choose between job offers was at least in part due to their practice of continuing in a position while shopping for a new one: they rarely left a job without having another one lined up.

The larger measure of job choice available to Ph.D. scientists than to many other occupational groups is suggested by a comparison of these findings with those from a study of a sample of the labor force in St. Paul, Minnesota, during about the same period (1940–50). In that study, close to a third of all the job terminations, and a fourth

* It was not practicable to select the scientists to be interviewed on a random basis. However, chemists, physicists, and biologists were represented in about the same proportion as among all the nation's Ph.D.'s in these three sciences. The age distribution of the respondents in each field also was similar to that of all Ph.D.'s in the given field. However, the relative numbers employed in colleges and universities were considerably lower and the proportions in private industry and government higher among the respondents than among all Ph.D.'s. Furthermore, few men in the study were employed outside the Middle Atlantic states. Despite these limitations, the attitudes expressed by the group of scientists interviewed are probably held by most Ph.D. chemists, biologists, and physicists, since Ph.D. scientists form a cohesive group, characterized by considerable shifting between university and other employment and by a high degree of geographic mobility, and since both these characteristics were found among the men in the study.

of those made by men in professional and kindred occupations, were found to be involuntary.*

Reasons for Job Decisions

The reasons given by the scientists for voluntarily leaving a job, for preferring one offered position to another, or for remaining on a particular job despite opportunities elsewhere are shown in the tables. In all three types of decisions, the considerations uppermost in the minds of most of these scientists were the interest of the work, the earnings and opportunities for advancement it provided, and the working conditions on the job. Less often mentioned in connection with these job decisions, but nevertheless determining in some situations, were such factors as security, personal considerations, the war effort, and the pursuit of graduate studies.

Job interest. This factor was the one most often given for continuing in a job for a long time (Table 1) and for choosing a particular job (Table 2). It ranked after earnings and opportunities for advancement, however, among the reasons cited for leaving jobs (Table 3).

What does a scientist mean when he says his job is interesting? What makes it "worth while and challenging"?

Many scientists stressed the importance of their work in extending the boundaries of science or in contributing to human welfare:

> "I have challenging problems. There is a chance for extending the whole field of chemistry. That is to say—does the theory built on the basis of small molecules apply to large molecules? Polymer chemistry is related to living matter; it is the riddle of life. Polymers have a tremendous technological significance; next to metals they are the most important materials."
>
> "The objectives are not generally as broad elsewhere. You can contribute more here. It means more to a larger number of people."

Others emphasized the opportunity for concrete achievement:

> "When you work for industry, you are at the forefront of research. Industrial research is done by a team possessing various skills. The team member can accomplish more than the individual scientist in the university."
>
> "Many universities don't do research except of the ivory tower type. I prefer to see the results of my research. It gives me a great thrill every time I see a package of 'Dot' on the grocery store shelf because I mixed the first batch of it."

For some men, it was the opportunity to develop and grow with a problem which was most important.

> "I have been developing the same problem during my twelve years stay at ———. I have no desire to change problems as long as progress is being made."
>
> "It takes 10 years for a good research job to mature. The problems are such that it takes years to work out. You keep going till you have extracted the juice."

Another job interest factor, most often mentioned in connection with the choice of a new job, was the chance to work in one's specialty, to grow and develop in this field:

> "The work represented a continuation of the research I had been doing for my doctor's thesis."
>
> "I chose this job because it was a chance to utilize my previous experience."

Interest in a particular field of specialization is not incompatible with a wish for new problems and broader experience, mentioned fairly frequently as a reason for changing employment. Nevertheless, some scientists accepted a particular job or continued in it because they wanted the even broader experience of work in several specialties.

> "I have remained with the company because of its diversity of interest. I like to move from one field to another. With the X Company the opportunity to shift fields is combined with the advantages of remaining with the same firm."
>
> "The Blank Company interviewed me in regard to

TABLE 1

REASONS CITED BY SCIENTISTS FOR REMAINING ON SAME JOB SINCE JANUARY 1942 OR EARLIER

Reason	Reasons cited	
	Number	Per cent distribution
Total reasons reported	**399**	**100.0**
Job interest	**132**	**33.1**
Worth-while and stimulating work	75	18.8
Work in scientist's field of specialization	18	4.5
Variety of problems	39	9.8
Working conditions	**128**	**32.1**
Total environment good	26	6.5
Freedom and independence	31	7.8
Good staff and supervisors	26	6.5
Good employer	28	7.0
Good research facilities	17	4.3
Earnings and advancement	**74**	**18.5**
Good salary or salary increase	36	9.0
Promotions	23	5.8
Pension program or other fringe benefit	15	3.7
Personal reasons	40	10.0
Security	16	4.0
Other reasons	9	2.3
Number of scientists reporting	137*	

* Excludes 13 scientists who did not report a reason for remaining and 18 who had no alternative offer worth considering.

* University of Minnesota Industrial Relations Center, "The Voluntary Shifts of St. Paul Workers, 1940–44 and 1945–50," unpublished manuscript, p. 6.

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many different specialties. I wanted to make myself flexible, so I chose their job."

Working conditions. In explaining their continued employment with a particular organization, the scientists who remained on the same job for many years mentioned the working environment almost as often as the work itself (Table 1). A considerable number of scientists also gave careful consideration to the prospective working atmosphere in choosing a job (Table 2). There were relatively few instances, however, in which active dissatisfaction with the working environment was mentioned as a reason for changing jobs. Like professional employees in general, scientists rarely work in physically unpleasant surroundings and are seldom subject to close supervision. This is undoubtedly one reason why unsatisfactory working conditions play a much smaller role in scientists' voluntary job exits than in the quits of manual workers.*

It is always difficult to single out the one element of the total job environment which pleases or disturbs. A number of scientists declared that many elements—freedom and independence, the research facilities, their supervisors and colleagues, the firm's policies and administration—together created a good or bad atmosphere for scientific work. The poor quality of the supervision and administration was the specific factor most often cited as a reason for leaving a job (Table 3). The caliber of their prospective co-workers and employer (either the individual organization or the type of organization) influenced more scientists in choosing a position than any other environmental factor (Table 2). In the case of scientists who had long remained with the same employer, freedom and independence led among the reasons for job satisfaction grouped under "working conditions" (Table 1).

Like all evocative words, freedom means different things to different people. For most of the government and industry scientists, it meant a voice in selecting their research problems:

> "One problem led to another, and I was allowed to follow my own inclinations. There has been more freedom than I could have anticipated elsewhere."
>
> "It is a new field and you pick your own topics. There is more freedom than there would be in old fields. No one can tell you what to do."

University teachers, who more often mentioned freedom and independence as sources of satisfaction than either government or private industry scientists, usually defined freedom more broadly:

> "University work offers many kinds of freedom—freedom of research, freedom of life, freedom from security investigations, and freedom to express oneself. It also provides freedom of time."

What these scientists stressed in assessing their supervisors and associates was competence in scientific work rather than administrative ability or humanity:

> "I like my associates. They are the top men in their scientific fields. It is a pleasure to work with them."
>
> "I admired and respected Dr. G., the head of the project. I consider him one of the most outstanding biochemists in the country."

In discussing their reasons for satisfaction with particular university, business firm, or government agency, some scientists emphasized the organization's reputation for high-caliber scientific work valued not only for the pride they could take in their work but also for the contribution the firm

TABLE 2

REASONS CITED BY SCIENTISTS FOR CHOOSING NEW JOBS, 1939–1951

Reason	Reasons cited	
	Number	Per cent distribution
Total reasons reported	**950**	100.0
Job interest	**308**	32.5
Worth-while and interesting work	50	5.3
Work in scientist's field of specialization	100	10.6
Interesting activity (teaching, research, or administration)	97	10.2
New or broader experience	61	6.4
Working conditions	**153**	16.1
Total environment attractive	22	2.3
Freedom and independence	29	3.1
Good staff and supervisors	44	4.6
Preferred employer	31	3.3
Good research facilities	27	2.8
Earnings and advancement	**229**	24.1
Salary increase or best salary offered	118	12.4
Good prospects for promotion	62	6.5
Earnings and chance for advancement generally good	49	5.2
Personal reasons	84	8.8
To study	84	8.8
Work close to defense effort	57	6.0
Security	10	1.1
Other reasons	25	2.6
Number of job entrances covered by table*	571	

* The 950 reasons for choosing jobs analyzed in this table applied to 571 voluntary entrances. The tabulation excludes 24 job entrances for which no reason for change of job was given and 75 where the scientists had only one job offered them.

* The findings of the University of Minnesota Study cited above suggest that the proportion of job quits due to unsatisfactory working conditions increases as one goes down the occupational scale (Appendix tables A-9 and A-10).

TABLE 3

REASONS CITED BY SCIENTISTS FOR LEAVING JOBS, 1939–1952

Reason	Reasons cited	
	Number	Per cent distribution
Total reasons reported	558	100.0
Job interest	118	21.1
General dissatisfaction with work	12	2.1
Not interested in field of employment or function	29	5.2
Desire for new or broader experience	47	8.4
Insufficient opportunity for research	30	5.4
Working conditions	62	11.1
Dissatisfaction with total environment	22	3.9
Insufficient freedom	6	1.1
Poor supervision	13	2.3
Bad administrative policy	14	2.5
Inadequate research facilities	7	1.3
Earnings and advancement	131	23.5
Inadequate salary or better offer elsewhere	79	14.2
Insufficient opportunity for advancement or better opportunity offered	52	9.3
Personal reasons	50	9.0
To study	67	12.0
War-connected reasons	73	13.1
Insecurity	43	7.7
Other reasons	14	2.5
Number of job exits covered by table*	406	

* The 558 reasons for leaving jobs analyzed in this table applied to 406 voluntary exits. The tabulation excludes 67 involuntary job exits, 94 due to the completion of studies, and 7 for which no reasons were reported.

reputation was expected to make in furthering their later careers. Others said they enjoyed the atmosphere of an efficient organization. A few scientists who had experienced frustration working for a large organization, pointed out the advantages a small one has to offer—a high degree of personal responsibility for the work and close ties with other members of the staff.

Implicit in every evaluation of an organization as a "good employer" was satisfaction with the equipment and assistance provided the research scientist. Some scientists, however, singled out the research facilities as one of the most important aspects of a job. One man said, "I have turned down other offers, including an offer to head up a cancer laboratory, because I believe that the Blank Institute offers the best facilities for cancer research."

Earnings and advancement opportunities. These essentially economic considerations played a greater part in the scientists' decisions to quit jobs and in the selection of new ones than in their long-continued employment with the same employer. Of all the reasons cited for job exits and entrances, about one-fourth related to earnings and advancement opportunities.* However, less than one-fifth of the men who had held the same job for a long period mentioned these factors as reasons for their employment stability.

The amount regarded as a good salary depends in the case of scientists, as for all of us, on a variety of considerations. Prevailing salary rates, the scientist's standard of living and family obligations, his expectations in a particular organization, the long-term earnings outlook, the professional status connected with the salary, and kind of offers received from other firms, all entered into the definition of a good salary. As the following quotations suggest, the consideration stressed in a particular situation depended both on the situation and the individual scientist.

> "The job I took paid $2000 a year—more than the going rate. That doesn't seem like much now, but some of my classmates made only $1600 or $1800.
>
> "I have four children and need an industrial salary."
>
> "I decided to leave the teaching field because the pay was poor."
>
> "A promised increase wasn't granted. So I left."
>
> "I didn't want to leave, but I was offered a thousand dollars more."

Past experience and future prospects, as the scientists saw them, also entered into their assessment of advancement opportunities. A number of men stayed on the same job despite offers elsewhere because they had been promoted rapidly: many left because they had not been advanced. In other instances, the decision hinged not on the past rate of promotion nor even on the outlook for the immediate future but rather on the long-run prospects. A scientist employed by a leading manufacturer of chemicals commented in explaining his transfer into that firm: "There was a chance for advancement because the company was already sold on research and was a big company."

Other factors. Besides the factors already discussed, the scientists mentioned job security, personal considerations, the war effort, and the pursuit of graduate studies as reasons for some of their shifts in employment.

The war was the most important cause of voluntary job exits between January 1, 1942, and August

* The younger men were particularly concerned with salary and/or advancement in choosing a job. After 45, other considerations were given greater weight.

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31, 1945. During the war years, many scientists—for patriotic reasons, to avoid being drafted, or because their jobs were threatened by war-created circumstances—transferred into defense work. After VJ-Day, there was a counter-movement into normal civilian activities.

Although few job exits or entrances were due to personal concerns—such as home ownership, family obligations, and the educational and cultural facilities of a community—they were the principal cause of some job shifts. One young man, for example, accepted a job because it was the only one offered him in his home town and he wanted to be close to his family. Another scientist left a position at the first opportunity because he regarded the schools in the locality as inadequate. A third transferred out of a field of work which had been his main interest for many years because his employer moved to another city, which he found overcrowded and otherwise "intolerable." Personal concerns were somewhat more frequently mentioned as reasons for leaving jobs by the men over 35 years than by the younger ones.

Job exits for purposes of study were largely confined to men under 30 years. The pursuit of a doctorate was a central consideration in the lives of the young men, however, accounting for a fifth of all the job exits made under 30, and is therefore of considerable importance in explaining the relatively high mobility of young scientists.*

Some Concluding Remarks

In summary, the focal point in these scientists' attitudes toward a job was the wish for worth while and interesting work. Inevitably, standards as to what is worth while and interesting vary in accordance with individual temperaments. By and large, the men were most interested in attacking a challenging research problem, preferably in their own specialty, and in making a contribution either to knowledge or to humanity. This aim took for granted a certain degree of independence on the job and the equipment and assistance required to carry it out. The scientists also looked for an atmosphere conducive to scientific research—an atmosphere in which capable and sympathetic supervisors and colleagues and a management committed to the support of a research program all played a part.

All this is not to say that scientists are above ordinary human considerations. They sometimes chose or left jobs for family or personal reasons. In the war period, a number of the young men shifted into war work in order to avoid the draft. And at all times, the desire for better earnings and advancement was at least as important in the decision to leave a job as any other single factor.

Some of the emphasis on interesting work noted here arose from the fact that during most of the period under review there was a shortage of scientists. Jobs were plentiful and salaries kept rising. Hence, scientists were in a position to look for interesting work. In part, however, this concern with the nature of the work can be expected of scientists, regardless of economic circumstances. In a study of scientists and engineers who had voluntarily left their government jobs in 1948,† the respondents were asked to list the professional and personal conditions which make a position desirable. Four out of five mentioned the opportunity to do interesting and important work under conditions of freedom and responsibility. The proportion who singled out adequate compensation and opportunities for advancement as essential requirements of a good job was smaller (60 per cent). Like all professional people, scientists tend to identify themselves with their work and to evaluate themselves primarily in terms of progress and achievement in their field.

* A number of young scientists had held assistant teaching posts while graduate students. When they received their doctorates, they left these positions. The 94 job exits due to the completion of studies are, however, omitted from the tabulation of reasons for voluntary job terminations.

† Clark D. Ahlberg and John C. Honey, *Attitudes of Scientists and Engineers About Their Government Employment*, Vol. I. Syracuse, N. Y.: Syracuse University, p. 37, (July 1950).

Allegory Within Allegory

KARL P. SCHMIDT

Karl Patterson Schmidt is Chief Curator of Zoology at Chicago Natural History Museum, where he has been a member of the staff since 1922. A native of Illinois, he was educated at Lake Forest Academy and College and at Cornell University. His more significant education, he feels, came from a Wisconsin farm and from his museum career in New York and Chicago. He regards folklore as one of the proper spheres of interest of a naturalist.

FOLKLORE at its best seems to be the product of a characteristic environment that provides atmosphere and background for the story. The more intimately the dark forest, the robber society, or the sea coast are involved in a given tale, the greater will be its measure of poetic truths. In the Story of the Fisherman and His Wife (in Low German) the Brothers Grimm found an extraordinary combination of moral allegory with Arabian Nights fantasy, set forth against a background of the moods of the North Sea. The lives and fortunes of those who live by the sea and from it may depend so intimately on even the faint nuances of the relations of water and weather that it is appropriate and meaningful that these relations should appear in their regional folklore.

The story of the humble fisherman and his domineering wife, beginning and ending in scenes of the most abject poverty, often runs in my mind, as one of my psychological familiars. In the allegorical story of their rise and fall, told against the sea-coast background, I now sense still deeper and more far-reaching meanings.

The gentle shelving slopes of the coasts of the North Sea are uncovered by the retreating tides as flats that may be many miles in width, on which

waiden von den Bömern, un
dat Water güng un brauſd
aß kaakd dat, un platſchdd an
dat Oever, un von feern ſeeg
he de Schepen, de ſchöten in
der Not, un danßden un
ſprüngen up den Bülgen.
Doch wör de Himmel noch
ſo'n bitten blau in
de Midd, awerſt
an den Sydea dor
tog dat ſo recht
H.V.93.

the rich variety of animal life must adjust itself to being uncovered by the twice daily ebb of the tides. All the living creatures of the great marine habitat are then dependent on the fresh supplies of food brought in by the returning flood. Such broad tidal flats have been veritable theaters of evolution, and for these the great types of marine animals have all provided actors whose adjustment to their roles has become perfected in geologic eras of the order of a billion years. Here on the tide-flats there were, in ages past, forerunners of the backboned animals, and it is not impossible that the earliest of our ancestors to depart from the invertebrate type may

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Von dem Fiſcher
und
ſyner Fru.
a wör mal eens en Fiſcher
un ſyne Fru, de waanten
ſoſamen in'n Pißputt, dicht an
der See, un de Fiſcher güng
alle Dage hen un angeld: un
he angeld un angeld.
So ſeet he ok eens by de
Angel und ſeeg jümmer in dat
blanke Water henin: un he ſeet
un ſeet.

have found the opportunity and the stimulus to do so in their progressive adjustment to the everlasting succession of tidal change.

The story to which I refer suffers a good deal in translation. In brief, it tells how a fisherman and his wife lived in such impoverished circumstances, close by the sea, that their hovel could only be described as resembling a chamber pot. How, in his daily angling, the simple and humble fisherman caught a halibut that spoke to him in Low German, begging for its life with the plea that it was

no true halibut but a bewitched prince. The fisherman needed no further evidence than the halibut's command of language to convince him that such a creature should have its freedom. Parenthetically I must remark that the usual English version of the story is unhappily weakened by the substitution of the word flounder for halibut. The halibut is indeed a flatfish, with both its eyes on the same side of the head, like the flounder; but whereas the flounder is familiar and ordinary, the halibut is from much deeper waters and is ten times as large. Before the days of modern fishing the halibut must have seemed, by comparison, a veritable monster of the deep.

On his return to their hut at the end of the day the fisherman told the story of the capture of the bewitched halibut to his wife. She is aghast at his simple generosity in giving so remarkable a creature its freedom without demanding a reward. Against his will, the fisherman is driven by her scolding to return to the sea, to call up the halibut and to ask the exchange of their hovel for a decent cottage with a modest garden. When he had left the sea, it had been in its most peaceful mood, with little wavelets lapping the shore and a play of pleasing blue on the distant deeper water. When he unwillingly returns with his wife's demand, the sea is ominously calm, and the peaceful blue has given way to greens and yellows. The halibut responds to the fisherman's conjuring verse, and the request for better living quarters is instantly granted.

Within two weeks, the wife is already dissatisfied with cottage and garden, thinking that she might quite as well have asked for a nobleman's castle and rule over the whole countryside. When she drives her husband back with this new demand, he finds the sea all gray, the wind rising, and the waves capped with white as far as the eye can see. Again he calls up the halibut, and again the wish is granted. Now, however, inordinate ambition has seized the wife. She sends her husband back, first with the demand to be made king and ruler over the whole country, then to be made emperor, and at last even pope, with rule over all the temporal princes of the world. On each return the storm has risen to a higher pitch, and when the halibut establishes the wife as pope, the fisherman is barely able to make his way against the wind. One must refer to Hermann Vogel's interpretation of the fisherman's wife Isabel in the role of pope to appreciate how simply this incongruous situation is faced in the story.

After these triumphs, even rule over the most powerful princes of the world is no longer enough for Isabel. She again drives her husband back to

call up the halibut and demand that she be made like God himself, with rule over the sun and moon and stars.

At the coast our fisherman now finds the storm so violent that he can scarcely stand. Houses and trees are being blown over, and even the mountains shake with great rocks rolling into the sea. The sky is inky black, lit up with flashes of lightning that are followed by rolling crashes of thunder. The sea had risen into dark waves as high as church steeples, comparable even with mountains, every one capped with a vast white crest of foam. Against the screaming gale the words of the little conjuring verse are soundless, whipped from the fisherman's lips with the driving scud from the towering waves. Even so the halibut again appears; but now it is to send wife and fisherman alike back to their original chamber-pot hovel.

A grim and terrible thought has not escaped the minds of the very leaders in modern man's rise to godlike command over the forces of nature. They see, as if written in lightning flashes against a black sky, that still another backdrop remains to be rung down if the fisherman's story be brought up to date, and that the tide-flats might then appear as empty of vertebrate life as when they were washed by pre-Cambrian seas.

Perhaps, even, sea and life might be gone altogether, man's final success (as was long ago suggested) having been announced to the universe in the birth of a new star.

THE FISHERMEN

Both lie and love
mark Peter's clan
They lie about the fish
they've lost
their faces scorched
their aching backs
their wet and weary feet
their empty creels
to hide their love
and guilt of love
of having lived
in fleeting fellowship
with flight
of wing
and wind
and cloud
of having known
the passage of a breath
no more
the cadence of free water
the grace of growth
the singing of the spinning sphere

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Self-Regulatory Behavior after Extirpation of Certain Endocrine Glands: A Review

FRANK B. STRANGE

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IN RECENT YEARS much attention has been directed toward the self-regulatory functions of the body. Probably the most outstanding worker in this area has been Walter B. Cannon, who suggested the term "homeostasis" to signify the constant conditions maintained by the body, conditions which may vary but which are relatively constant. Although the term is new, Cannon points out that the ability of living beings to maintain their own constancy has long impressed biologists, and he lists several scientists who have given expression to this thought: Hippocrates (460–377 B.C.), Pflüger (1877), Leon Fredericq (1885), and Charles Richet (1900). Cannon has directed his research in this matter, as summarized in *The Wisdom of the Body*,[1] mainly to study of the relation of the autonomic system to the self-regulation of physiological processes.

Another investigator who has contributed to the knowledge of self-regulatory functions is Curt P. Richter, who has approached the field in a different manner, through the study of endocrine glands. Writing in 1941,[2] Richter pointed out that only recently was it realized that the ability of animals to satisfy internal needs under a great variety of normal and pathological conditions by appropriate activity could be understood in terms of a broad biological concept first stated in 1859 by Claude Bernard—the concept of constant internal environment. Richter indicated that Bernard and Cannon have laid stress upon some of the single factors which help to maintain a constant internal environment. "In addition," he states, "we believe that the ability of animals to maintain a constant internal environment, after certain single organs or physiological regulators have been removed, clearly establishes the existence of behavior or total organism regulators."[2]

It is the purpose here to review research related to the self-regulatory behavior of animals following removal of certain endocrine glands. Since the great majority of research in this area has utilized the rat as the experimental animal, and for the sake of unity, only experiments using the rat will be reported. Studies concerned with the following will be considered: (*a*) the relationship between aspects of behavior and body temperature following hypophysectomy; (*b*) the relationship between aspects of behavior and water balance after extirpation of the posterior lobe of the pituitary; (*c*) the relationship between aspects of behavior and the sodium concentration of the blood following adrenalectomy; (*d*) the relationship between aspects of behavior and the calcium concentration of the blood after parathyroidectomy; (*e*) the relationship between aspects of behavior and diabetic symptoms following pancreatectomy.

Body Temperature

The chief regulators of body temperature are the thyroid and the anterior lobe of the pituitary. Death will result within a few days if animals from which either of these glands has been removed remain in even slightly lowered external temperature.[2] Kinder[3] has reported that nest building is inversely related to environmental temperature. Animals that were given access to paper used little and made small and loosely constructed nests at room temperature. Nest building activity was greatly increased as was the quality of nest con-

struction when the temperature was lowered. The behavior of the rats served apparently to maintain a constant body temperature.

Employing a modification of cages used earlier by himself[4] and by Kinder for studying nest building in the rat, Richter[5] found that hypophysectomy produced a marked change in nest building activity. The animals were kept in individual compartments measuring 12 by 11 inches with a meshed wire screen covering the front. A device was attached to the outside of the cage which consisted of an axle with a roll of soft tissue paper one-half inch wide by 500 feet long and a cyclometer for measuring the length of paper taken from the roll The end of the paper hung freely inside the cage within easy reach of the rat. The cyclometer was read at noon each day at which time the paper pulled in by the animal during the preceding 24-hour period was removed. Even though the paper was taken from the cage, normal rats, both male and female, built nests each day. Under constant conditions the amount of paper used from day to day remained "amazingly" constant for males and females alike.

It was found that hypophysectomy regularly produced a large and permanent increase in the nest building activity. Effects on nest building of gonadectomy, adrenalectomy, and thyroidectomy were also studied. Small increases were produced by adrenalectomy and gonadectomy, whereas large and permanent increase equal to that resulting from hypophysectomy was regularly produced by thyroidectomy. It was thought that the increased nest building activity after extirpation of the pituitary was due to the atrophy of the thyroid which it caused. Richter states that the hypophysectomized rats build larger nests in an effort to keep up their normal metabolism.

Referring to this study, Richter comments at a later date, "Thus, after thyroidectomy or anterior lobectomy and the resultant decrease in heat production has threatened the maintenance of a constant body temperature, the rats themselves made an effort to maintain a constant body temperature by building large nests around their bodies, thereby reducing heat loss."[2]

Water Balance

One of the main regulators of water balance of the body is the antidiuretic hormone which is secreted by the posterior lobe of the pituitary gland. Extirpation of the posterior lobe results in the displaying by the animal of the symptoms of diabetes insipidus, i.e., abnormally severe thirst (polydipsia) and excessive urination (polyuria).[6] These difficulties are relieved promptly by injection of an extract from the posterior pituitary.[7] Dehydration and death will follow, however, if the animals receive neither more than the normal amount of water nor hormonal injections. When dehydrating factors operate on the intact animal, an increased amount of the antidiuretic hormone is secreted which causes the kidney to excrete less urine, thus the body loses less water. On the other hand, when the body has an oversupply of water, hormonal secretion is decreased resulting in greater excretion of liquid.[8]

Drawing from a previous experiment,[9] Richter notes that if rats from which the posterior lobe has been surgically removed are allowed free access to an unlimited supply of water, they will ingest sufficiently large amounts to keep themselves alive and in good health. "The increased water intake," summarizes Richter, "represents to us an effort of the animal to maintain a constant internal environment, compensating for polyuria, which is primary."[2]

In a more recent report, Richter[8] indicates that experiments in his laboratories have shown that when rats from which the posterior lobes have been removed were not given access to water, they lost up to one-sixth of their body weight within eight hours after the operation and died much sooner than did intact animals that were deprived of water. When the operated rats were given access to water they consumed very large amounts, some drinking every day nearly double their body weight, and as a result kept themselves alive and in good health indefinitely.

Sodium Balance

Adrenalectomized animals show an increase in the urinary excretion of sodium and a decrease of the sodium concentration of the blood.[10] Young[11] has noted that rats usually die from excessive loss of salt in 10 to 15 days after adrenalectomy. It has been shown by Gaunt, Tobin, and Gaunt[12] that the length of survival of adrenalectomized animals is increased if they are forced to ingest a sufficient amount of salt. And Rali[13] has demonstrated that survival following adrenalectomy is enhanced by feeding sodium chloride

In an experiment by Richter,[14] 13 adrenalectomized rats were put on a saltless diet following the operation. The survival rate was found to be zero per cent and the average length of life after adrenalectomy to be 11 days. With 26 animals continued on the standard McCollum diet (approximately 0.145 gram of salt per day) after adrenalectomy, the survival rate was 39 per cent and the average duration of life of the animals that died was 17 days. A third group of 13 rats was kept on the

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standard diet but in addition was given the choice of tap water or 1 per cent salt solution. These animals ingested a larger quantity of the salt solution after adrenalectomy, and the survival rate was increased to 69 per cent. Yet another group, made up of 5 rats, was kept on a saltless diet but was given a choice between tap water and a 3 per cent salt solution. Six times as much salt solution was ingested after adrenalectomy, and a survival rate of 80 per cent was shown. Richter concludes that the salt appetite is greatly increased by adrenalectomy and that the survival rate is greatly increased by virtue of the appetite.

In another study with adrenalectomized rats, using the single choice method, Richter and Eckert[15] found that the mortality, in general, varied inversely with the intake of sodium, with a reduction from 100 per cent to zero per cent. This study and also one by Young and Chaplin[16] have strongly supported the view that the adrenal gland regulates a specific hunger for sodium rather than sodium chloride. Bare[17] has also reported an increase in the strength of salt drinking behavior of adrenalectomized rats, as have Richter,[18, 19] Clark and Clausen,[20] and Mark.[21] In the general conclusions of a rather recent article, Young and Chaplin state, "If adrenalectomized rats are given unlimited access to salt solutions at the optimal or near optimal concentration, they can survive indefinitely and in seemingly good health and activity."[16]

Calcium Balance

A hormone (parathormone) secreted by the parathyroid controls the concentration of ionic calcium in the blood. Removal of the parathyroid stops the flow of that hormone which in turn causes the calcium concentration of the blood to drop below normal. This affects the central nervous system, produces increased irritability of the peripheral nerves, and results in tetany which can be cured by an extract of parathyroid glands.[10] The conclusive state can also be checked by injection of calcium salts, and if administration of calcium is in sufficient quantities, all the symptoms of tetany can be held in check.[7] However, if no treatment is given, the parathyroidectomized rat ordinarily loses weight, develops symptoms of tetany, and dies.[2, 11] The parathyroid maintains the phosphorus as well as the calcium balance in the blood, but there is a rise in the level of phosphorus in the blood and, if administered in the diet of animals after removal of the parathyroids, results in or increases tetany as the case may be.[22] It is also known that parathyroid tetany improves under treatment with strontium[23] and magnesium[24] salts.

In a study to determine the level of calcium appetite in rats before and after parathyroidectomy, Richter and Eckert[25] allowed the animals free access to a 2.4 per cent calcium lactate solution. The investigators report that the appetite for calcium lactate was definitely increased by removal of the parathyroid in 17 or 18 rats. The animals seemed to make an effort to satisfy their increased need for calcium by ingesting large quantities of the liquid. Although it seemed quite likely from the data that parathroidectomized rats have a craving for calcium, it was felt that such a conclusion was unwarranted since only calcium lactate was employed. So the same investigators conducted another experiment in which rats were allowed to select from several different solutions.[22] A markedly increased appetite for calcium solution, which included lactate, acetate, gluconate, and nitrate, and an aversion toward dibasic sodium phosphate were shown by the rats after parathyroidectomy. After the operation the rats also showed an increased appetite for strontium and magnesium salt solutions. When the operated animals were given free access to the calcium solutions, they made selections which reduced their mortality to zero, greatly improved the tetany, and either eliminated or reduced the loss of weight which had occurred. It was concluded that the decreased mortality and alleviation of deficiency symptoms of the parathyroidectomized rats given access to calcium solutions furnished additional evidence that rats have an ability to make selections conducive to their well-being.

Wilens and Waller[26] found that when completely parathyroidectomized rats on low calcium diets were given a choice of calcium lactate or sodium phosphate solution, they showed an increase in the amount of calcium and a decrease in the amount of phosphorus ingested. Young[11] comments that not only do parathyroidectomized rats select more calcium, but they also exhibit an aversion to phosphate. Such animals demand a diet high in calcium and low in phosphorus, and they refuse to partake of diets low in calcium and high in phosphorus.

Carbohydrate Balance

That the lack of the pancreas causes diabetes was discovered in 1890, and it was later demonstrated that the pancreatic hormone is carried in the blood stream and that pancreatectomized animals can be kept normal by injection of the pancreas hormone, insulin.[7] Insulin is important in carbohydrate metabolism and without it the concentration of blood sugar increases and polyuria and polydipsia develop.[8]

A rat kept on a standard diet after pancreatec-

tomy will develop all the symptoms of diabetes.[6] (It is noted by Harrow[10] that pancreatectomy is fatal to the dog, with the death of the animal occurring in one to two weeks and that the length of survival of cats after removal of the pancreas is about five to six days.) Of 28 rats kept on the standard McCollum diet by Richter and E. C. H. Schmidt[27] in a study of behavioral and anatomical changes produced by pancreatectomy, only 10 of the animals survived the 40-day observation period following the operation. Pancreatectomized rats, this study found, became quite inactive. It was concluded that the inactivity was due largely to the inability of the animals to metabolize carbohydrate.

A later study by Richter and C. H. Schmidt, Jr.,[28] was concerned with the questions of whether pancreatectomized rats seek fat or carbohydrate and of whether their food selections actually help to maintain the constancy of the internal environment. Seven early pancreatectomized rats were kept on the standard McCollum diet after operation, and all developed marked diabetic symptoms—polydipsia, increased food intake, decreased rate of growth, and hyperglycemia. Several weeks after these symptoms had developed the animals were placed on the self-selection diet. It was found that a marked appetite for fat and olive oil was shown by the rats and they ate little or no carbohydrate, which in this experiment was sucrose. An increased appetite was manifested by all 7 animals for yeast. On the self-selection diet the diabetic symptoms of all the rats either disappeared or were greatly reduced. Upon the return to the McCollum diet, diabetic symptoms were again shown by 4 of the 7 experimental animals.

In the same study another group consisting of 8 rats was kept on the self-selection diet for at least 40 days before pancreatectomy and for an equal period of time following the operation, at which time they were put on the McCollum diet. After pancreatectomy all the animals selected more fat and little or no carbohydrate. Measured in calories, the intake of carbohydrates changed from 36 to 9 per cent; fat from 38 to 68 per cent; and protein remained unchanged, 26 to 23 per cent. Diabetic symptoms appeared in none of the pancreatectomized rats as long as they were allowed to select their own diet. After being placed on the McCollum diet, 5 of the 8 animals showed polydipsia, increased food intake, reduced rate of gain of weight, and hyperglycemia.

From these experiments Richter and Schmidt conclude that the rats helped correct their diabetic symptoms by their selections of food and that their selections were in close agreement with the known needs of human diabetics. The authors conclude also that the various responses of the diabetic rats can be explained in terms of Claude Bernard's principle of the maintenance of the internal environment.

A later study by Richter, Schmidt, and Malone[29] dealt with the dietary selections of rats made diabetic by pancreatectomy. After removal of the pancreas, rats maintained on the standard diet developed diabetic symptoms. The animals were then placed on a self-selection diet, and they made dietary selections which caused all the diabetic symptoms to disappear. In general, the results confirm the finding of Richter and Schmidt,[28] reviewed above, that the rats tend to make dietary selections which favor health.

Summary

Much attention has been devoted in recent years to the self-regulatory functions of the body. The outstanding work of Cannon in this field is probably the most widely known. Whereas his studies have been primarily concerned with the physiological regulations of the internal environment, much of the work of Richter has dealt with the maintenance of the constancy of the internal environment through the operation of behavior regulators. Research pertaining to self-regulatory behavior in rats after extirpation of certain endocrine glands is reviewed.

Body temperature is regulated chiefly by the thyroid and the anterior lobe of the pituitary. Animals from which either of these glands has been removed will die within a few days if the external temperature is even slightly lowered. Nest building activity in normal rats is inversely related to environmental temperature. Thyroidectomized and hypophysectomized rats display greatly increased nest building behavior, producing larger and better constructed nests. This is interpreted as an attempt by the animals to compensate for reduced metabolism and to maintain a constant body temperature.

The water balance of the body is regulated primarily by a secretion of the posterior lobe of the pituitary. Surgical removal of this gland results in polyuria and other symptoms of diabetes insipidus which will be followed by dehydration and death. After such an operation rats who are allowed free access to sufficient quantities of water will ingest enough to keep themselves alive and in good health indefinitely. This may be viewed as an attempt by the rat to maintain a constant internal environment.

Adrenalectomy causes a decrease in the sodium concentration of the blood and in rats will result in

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death from excessive loss of sodium in 10 to 15 days. Adrenalectomized rats that are put on a self-selection diet including a sodium solution of optimal or near optimal concentration will ingest a sufficient amount of it to survive indefinitely in apparently good health. This is also viewed as an effort on the part of the animal to compensate for an internal deficiency and thus maintain a constant internal environment.

Calcium concentration of the blood is controlled by parathormone, a secretion of the parathyroid. Extirpation of this gland results in tetany and death. If parathyroidectomized rats are allowed free access to calcium solutions, they will consume a quantity sufficient to either eliminate or reduce the tetany and avoid death. This may likewise be seen as an attempt by the animal to restore the constancy of the internal environment.

Pancreatectomy stops the flow of insulin which results in diabetes. Such animals are unable to metabolize carbohydrates and should avoid them. Pancreatectomized rats develop diabetic symptoms while on the standard diet, but when placed on a self-selection diet, these animals ingest little or no carbohydrate and larger amounts of fat, thus either eliminating entirely or greatly reducing the diabetic symptoms. This is interpreted as an effort by the animal to maintain a constant internal environment.

It is concluded that rats have a tendency toward and the ability to induce, in a permissive situation, behavior which will maintain the constancy of the internal environment. It is felt that this principle of the constancy of the internal environment may be of value in understanding activities of the total organism.

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The Sleep-Wakefulness Pattern in the Arctic

NATHANIEL KLEITMAN and HORTENSE KLEITMAN*

Nathaniel Kleitman, professor of physiology at the University of Chicago, has been investigating sleep for over thirty years. To determine the influence of unusual environmental conditions on the diurnal sleep-wakefulness rhythm, he has made studies in Mammoth Cave, Kentucky, in submerged submarines, and more recently in the Norwegian Arctic. Hortense Kleitman, a graduate of the University of Michigan, where she majored in sociology, is with the Chicago Research Department of the advertising firm of Young and Rubicam. She has served her father as a "guinea pig" since infancy; this marks her debut as his co-worker.

THE consolidation of the several irregularly distributed daily sleep fractions, characteristic of the newborn infant, into one continuous nightly sleep period, in older children and adults, represents an acculturation of the individual to the family and community routine of living. This routine, in turn, is an adaptation to the astronomical alternation of darkness and light, resulting from the 24-hour periodicity of the rotation of the earth about its axis.[1] In the two polar areas, however, there is a season of continuous darkness and one of continuous light. How do these seasonal extremes affect the sleep-wakefulness pattern of the residents of these far-away regions of the earth?

The Antarctic is practically uninhabited, and in the Arctic of the Western Hemisphere there are no communities of any size. In the Eastern Hemisphere, however, there are cities of about 10,000 inhabitants, with a highly organized community life, north of the Arctic Circle, in both Sweden (Kiruna) and Norway (Narvik and Tromsø). Information gleaned from travelogues and occasional books dealing with Scandinavian countries points to a profound effect of continuous summer daylight upon the sleep routine of the denizens of the North. Travelers who usually visit these parts in the summer invariably report that people can be seen in the streets of arctic towns at all hours of the night. Dudley V. Talcott,[2] a sculptor and sailing enthusiast, who spent several summers cruising in arctic waters, related that he "often heard the people down in the south of Norway say that everyone in Nordland and Finmarken is crazy. They say that no one who eats so much fish and who gets no sun at all for three months in the winter and so much sun that he doesn't go to bed at all during the summer can help but be a little cuckoo." Talcott "would not be surprised if a scientist should some day come out with the discovery that the sun actually creates a tide within the substance of one's brain." Also, every spring, the advent of the touring season brings forth a number of articles on the attractiveness of the Arctic and the peculiarities of its people. In March, 1952, in the *New York Times*, Oden and Olivia Meeker,[3] referring to Lapland (Norwegian-Swedish-Finnish Arctic), declared that "people are apt to sleep only three or four hours a day during the summertime here."

As anecdotal information on other aspects of the diurnal routine of living has proved to be, on close examination, highly inaccurate, and as a sojourn in Tromsø, in the summer of 1951, was made for a study of a purely physiological nature, it was decided to venture into sociological research of the community sleep-wakefulness pattern. This was to be done by direct count of the number of persons that passed a particular central point of Tromsø at different hours of "day" and "night," as well as by intensive interviews with a sample of the population of the town.

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General view of Tromsø, Norway.

Tromsø is located at 69°39′ N, 18°58′ E, and occupies a portion of the east shore of the small, hilly, oblong island, Troms (Tromsøya), six miles long (N-S), and two miles at its widest. The Tromsø sound, at the site of the town, is only about half a mile wide, and a ferry boat furnishes communication with the mainland at half hourly intervals. To the west there are outcroppings of one very large island (Kvaløya) and several smaller ones. A couple of miles west of the southern tip of Tromsøya lies the wreck of the German battleship Tirpitz, which turned turtle and sank in shallow water from the effects of near misses from RAF bombers. Because of the latitude, the mountains of the mainland and nearby Kvaløya, though only two to three thousand feet in height, are covered with snow for the greater part of the year. Tromsø therefore appears to be surrounded by truly magnificent alpine scenery.

The town is about 200 miles north of the Arctic Circle and 1400 miles from the North Pole. The sun describes a daily circle in the sky, but remains above the horizon, from May 21 to July 23, daylight thereafter decreasing unevenly to 12 hours per day at autumn equinox and down to nothing by November 21, when the period of complete darkness begins. From about January 23, when the sun reappears, the length of the day increases until continuous daylight is reached by May 21. The climate in that part of Norway is relatively mild, due to the nearby passage of the Gulf Stream. The winters are quite stormy, but the mean air temperatures from December to March are only 25–27° F, whereas in July and August they are about 52° F. Because of continuous daylight, the growth of vegetation during the short summer is quite lush. Trees are covered with leaves and flowers bloom in the open, while cattle browse in the meadows surrounding the town. This part of Norway is the only region in the world where cereals (rye and barley) can be raised so far north.

Tromsø is called the Capital of the Arctic. Administratively, it is the capital of Troms county and bishopric. It has a large hospital, staffed with an imposing roster of full-time physicians and surgeons. A state broadcasting station, a daily newspaper, a weather forecasting establishment (one of three in the whole of Norway, the other two being at Oslo and Bergen), a Northern Lights Observatory (built on a grant from the Rockefeller Foundation), consulates and consular agencies of several countries, banks, primary, secondary, and professional schools—all these contribute toward making the town something of an intellectual center also. Commercially and industrially, Tromsø's eminence rests upon the possession of three fine harbors and its location on the main north-south sea route. Sealing, whaling, and Arctic exploratory expeditions start from here; fish, seals, and whales are brought in for processing, oil extraction, and manufacture of fertilizer; and there is a thriving shipbuilding and outfitting industry. A daily passenger-mail-freight service is maintained in both south and north directions, and there are also bus connections with Kirkenes, on the Russian border, and with Lønsdal, the northern railhead of the Norwegian system, just above the Arctic Circle. In addition, during the summer, a seaplane line operates on a five times a week schedule to and from Oslo, only five hours away, from an air harbor on the Troms island, about two miles north of the town limits.

The pace of life in Tromsø, during the summer months, at least, is leisurely, people strolling through the streets, looking into store windows, stopping to chat with friends. Occasional Lapps, in their picturesque multicolored costumes, add brightness to the otherwise drab street scene. The daily work stint in stores and offices is from 8–9 A.M. to 3–4 P.M., with a break of a few minutes at noon, for coffee and cake or a sandwich, usually brought from home. The principal family meal of the day (*middag*) is served shortly after the conclusion of the day's work, between 3:30 and 4:30 P.M. Thereafter, until bedtime, the several members of the family are entirely on their own with respect to activity, as supper (*aftens*), in the form of a light snack, is usually eaten individually some time in the course of the evening. Municipal electricity is time-rationed, and current is not available after 9 P.M. This is of no consequence in the summer, but in the other seasons the current shut-off becomes an obligatory bedtime hour for those who have provided no other means of illumination (candles, kerosene lamps, electricity from home-

size gasoline or diesel engine dynamos). Hospitals and other institutions operating around the clock have rather powerful auxiliary electric stations.

A cinema showing some of the latest American and British films runs on a fixed schedule of single shows, one in the late afternoon and another in the evening. There are evening band concerts in the city hall plaza during the summer. Informal parties, with endless sampling of good things to eat and drink, and enlivened by group singing, are likely to continue way past midnight, as it seems to be late afternoon throughout the whole period of conviviality. Outdoors, in the summer, it is not unusual to see people engaged in mowing the lawn or playing a game of tennis around 11 P.M. In the streets there is considerable circulation, on foot and by bicycle, in what corresponds to late evening hours in lower latitudes.

Direct observations of "night life" in Tromsø, during the summer of 1951, revealed a sharp drop in street traffic shortly after midnight, except in the vicinity of the harbor. As in other rather isolated arctic towns, the big events of the day were the dockings of the regular mail-freight-passenger steamers, northbound for Kirkenes and southbound for Trondheim and Bergen. At Tromsø the north-going boats usually arrived at about 5 P.M. and departed three hours later, and they brought many passengers, tourists from southern localities or Tromsøites returning from their vacations. Relatively few persons departed from Tromsø for towns farther north in the steamers' itinerary. Just the opposite was true of the south-going boats, arriving at about 11 P.M. and departing at 2 A.M. Great numbers of passengers, southbound on business or pleasure, with accompanying relatives and friends, would gather at the pier prior to the arrival of the steamer. The prevailing animation of this expectant crowd makes it easy to understand why cruise passengers, making their first and only round trip from Bergen to Kirkenes, get the impression (and later relate it in articles and books) of feverish activity in Tromsø and other arctic towns, no matter what the hour of the docking of the steamers. If they ventured into neighboring streets during the boat stopover, they would also see a good deal of movement. Had they wandered farther from the pier, they would notice a progressive thinning out of traffic and also that it invariably radiated away from or toward the harbor. What the travelers could not record, however, was the *complete* cessation of vehicular and pedestrian movement in the whole city half-an-hour to an hour after the departure of the boat. Aside from an occasional police motorcycle with side-car, or a baker or post-office worker coming out for a breath of fresh air, the streets of Tromsø were absolutely deserted. The broad daylight and red sun hugging the horizon accentuated the eerie ghost town aspect of the Capital of the Arctic in these early hours of the morning.

The authors, with their young friend, Erik Winther-Hansen, on a visit to a whale-processing yard, on the outskirts of Tromsø. (Photo by Sigurd Winther-Hansen.)

There was only one night during which circulation through the streets of Tromsø was considerable, continuous, and rather boisterous, and that was Saturday, June 23, "Midsummer Night," when the midnight sun was highest above the northern horizon. In more southerly latitudes great bonfires are lit in the fields or on mountain tops during that night, but in the Arctic the sun would make these fires practically invisible. The Tromsø celebrants therefore used smoke-producing materials for fuel, and billows of smoke rising from the midst of clumps of human beings, as well as the sustained hilarity of the revelers, testified to the carnival nature of these nocturnal gatherings.

As our original intention of making an accurate hour-by-hour count of the number of persons crossing the central square of the city, around the clock, was defeated through the complete desertion of streets during the night, it became necessary to turn to the indirect method of personal interview for establishing the diurnal activity pattern of the inhabitants of Tromsø. Luckily, it was possible to secure the services of a trained Norwegian interviewer, a sociology student at the University of Oslo, with considerable experience in assisting several U.S. sociologists in studies they carried out in Norway, under the Fulbright Act. This interviewer had a very good command of English, especially of the technical terminology of the sociological interview, and he cooperated in the preparation, pretesting, and subsequent improvement of the questionnaire, interviewed the subjects in Norwegian, and

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translated the data obtained into serviceable English. Further treatment of information, such as coding and tabulating the replies, was carried out by the staff of the National Opinion Research Center of Chicago.

Each "depth" interview lasted about one hour and took the form of a conversation with the subject. The order in which the questions were asked was not always the same, nor was it possible to get clear-cut answers to all questions from each subject. It was found best not to limit the interview to the topic of sleep, but rather to make it a general attempt to detect seasonal variations in the routine of living, including meals, work, and recreational activities.*

So far as they could be elicited, answers to each item of the questionnaire were obtained with respect to (1) the day of the interview, or the preceding night, (2) the summer months in general, and (3) the winter months. As the study was made in the summer, (1) and (2) were compared for consistency, and (2) and (3) for seasonal agreement or variation. The interviewer was a "good mixer" and made friends easily. At no time was information sought without an adequate introduction and an explanation of the purpose of the study. Although some persons refused to be interviewed, the majority of those approached seemed eager to cooperate and, as a rule, volunteered additional information, not always relevant. The problem of proper sampling came up during the pilot study, but after an attempt to secure a scientifically random sample on the basis of census figures, it was finally decided to aim for individuals who were articulate enough to furnish the desired information. Thus, the better educated groups were represented out of proportion to their numbers in the general population. The subjects were recruited through personal contacts and the recommendation of others, but as the investigation progressed, a deliberate attempt was made to overcome early bias in sampling by extending the interviews into age, education, occupation, and residence areas that would ensure a more balanced distribution This required "door-bell ringing" in a considerable number of cases. Because of the time consumed by the interviews, and the subsequent translation of the answers into English, the size of the modified "quota" sample was limited to 100, or about one per cent of the population of Tromsø.

As already indicated, it was not always possible to ask all the questions. Also, some of the answers were so ambiguous as to defy proper translation and coding. It was therefore necessary, for some items in the questionnaire, to confine the analysis to a portion of the answers, rarely, however, to less than fifty. Where some of the replies could be checked against others—as, for instance, the hours that elapsed between going to bed and getting up against the respondent's own estimate of the duration of his sleep—the figures did not always agree. The majority of the subjects tended to underestimate the duration of their sleep. However, where the differences between numerical means of several variables were treated statistically, their significance, if any, was easily established, even when the numbers involved were small.

Of the 100 subjects, 49 were males, and 51, females. Eight, students in the local secondary school and in a college of navigation, were under 20 years of age; 34 were between 20 and 39; 39, between 40 and 59; and the remaining 19, 60 or over. Their scholastic attainments could not always be determined by direct questioning and, at times, had to be inferred from their occupation or status. Definite data on 52 subjects (31 men and 21 women) revealed that six (students) had completed primary school; 22 (9 men and 13 women), secondary school; and 24 (19 men and 5 women) had higher, usually technical, education. It is safe to assume that the unlisted 48 subjects had little or no formal schooling. No pretense is made that one-quarter of the population of Tromsø had college or university training, and, as would be expected, our sample was also biased with respect to occupation. About one-third were professional or business people; another third, housewives; and the remainder, skilled or unskilled manual workers, students, and retired. Of the 100, 64 were married and 36, single or not living with spouse. The number of individuals per family unit varied from two to seven; 37 included children, usually one or two per family. Four-fifths of the subjects had lived in Tromsø more than five years.

The respondents' daily routine of living was about the same as that of the general population of northern Norwegian towns. A breakdown of the coded replies revealed that the prevailing mode of awakening in the morning was "spontaneous," with alarm clocks not a very close second, and arousal by another member of the family, third. Breakfast was eaten anywhere from 5 to 10 A.M., mostly at 8–8:30, almost immediately upon getting up. Coffee was by far the favorite beverage at breakfast, but some drank milk, and a few, tea. Dinner time stretched from noon to 5 P.M., with

* Data were thus gathered on several aspects of living, omitted from this report, such as the length of the working day, group activity outside the home, hours of meals, habits of other members of the respondents' families, etc.

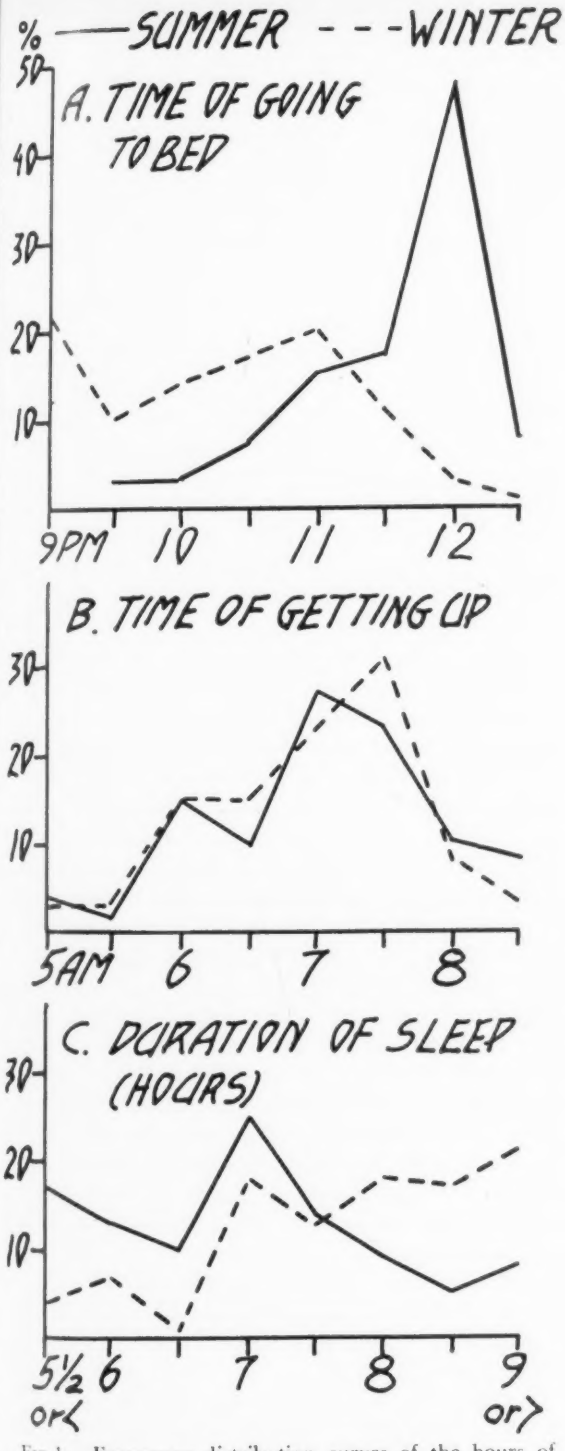

FIG. 1. Frequency distribution curves of the hours of going to bed and getting up, as well as the duration of sleep.

distinct modes at 12:30–1 P.M. for 'stay-at-homes' and 3–4 P.M. for those who came home at the end of the working day. Supper hours ran from 5 to 9 P.M., but the majority ate between 7 and 9. The choice of beverage at dinner and supper was fairly equally divided among coffee, milk, and tea. Some drank coffee later in the evening.

Although 33 persons reported having had naps the day before they were interviewed (12 naps lasting less than 45 minutes, and 11, an hour or longer), very few admitted that they took after-dinner naps regularly, especially in the summer. Leisure-time activities were the same in the summer as in the winter for one third of the group; the other two thirds engaged in different activities, mostly outdoor in the summer, indoor in the winter. Friends and relatives were visited somewhat more frequently in the winter than in the summer.

As previously stated, the shutting off of electricity could have no effect on the time of retiring in the summer, but in the winter nearly one-quarter of the subjects were in bed by 9 P.M. Few persons had individual bedrooms, the great majority sharing theirs, as a rule, with one other member of the family, some, with two or three others. More people left their bedrooms undarkened during the night in the summer than bothered to pull down the shades. Indeed, many bedrooms had no shades. The town was very quiet at night, and there were no noises to disturb the sleepers in any season of the year. Three-quarters of the subjects used no sedatives or hypnotics at any time, but the few who occasionally resorted to them did so more often in the winter than in the summer.

Going to bed. The percentage frequency distribution of the hours of retiring for the night is shown in Figure 1A. During the summer, the respondents went to bed as early as 9:30 P.M. and as late as 12:30 A.M., but 78 per cent retired from 11 P.M. to midnight. The distinct mode at midnight represented the highest percentage for any of the six frequency distribution curves in the figure and, on the breakdown of the data by sex, age, and occupation, was found to apply to men as well as women; to those under and those over 40 years of age; and to housewives, professional persons, and manual workers. The mean going-to-bed time was 11:36 P.M. (Table 1, A). Although the range of the hours of retiring was about the same in the winter as in the summer, the percentage distribution curve in the former reveals no sharp mode at any hour, but a gradual increase till 11 P.M. In the winter, the mean group retiring hour was 10:32 P.M., or over one hour earlier than in the summer. This seasonal difference was statistically highly significant (P less than 0.000001). Furthermore, in both seasons, men seemed to retire later than women, and older persons, later than younger ones. These sex and age disparities were probably connected with

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TABLE 1

MEAN VALUES, AND STANDARD DEVIATIONS, FOR HOURS OF RETIRING AT NIGHT, ARISING IN THE MORNING, AND DURATION OF SLEEP

	Summer months	Winter months	Difference
A. Hours of Retiring at Night (P.M.)			
Entire Group (75 & 88)	11:36 ± 41′	10:32 ± 61′	64′†
Professionals (28 & 28)	11:53 ± 23′	11:05 ± 31′	48′†
Housewives (26 & 29)	11:31 ± 41′	10:02 ± 56′	89′†
Difference	22′*	63′†	
B. Hours of Arising in the Morning (A.M.)			
Entire Group (48 & 39)	7:02 ± 52′	6:57 ± 46′	5′
Professionals (18 & 15)	7:16 ± 33′	7:12 ± 30′	4′
Housewives (15 & 12)	7:02 ± 53′	6:50 ± 41′	12′
Difference	14′	22′	
C. Duration of Sleep			
1. Based on A. and B.			
Entire Group	7h.26′	8h.25′	
Professionals	7h.23′	8h. 7′	
Housewives	7h.31′	8h.48′	
2. Based on subjects' estimates			
Entire Group (87 & 71)	7h. 1′ ± 62′	7h.48′ ± 62′	47′†
Professionals (28 & 27)	6h.40′ ± 49′	7h.26′ ± 51′	46′‡
Housewives (27 & 17)	6h.58′ ± 64′	7h.56′ ± 65′	58′‡
Difference	18′	30′	

Figures in parentheses indicate the numbers of subjects whose data supplied the mean values for summer and winter, respectively. Degrees of statistical significance of the differences between the means, based on R. A. Fisher's *t* method: * $P<0.02$; † $P<0.001$; ‡ $P<0.01$.

occupational factors: housewives went to bed earlier than did the professional people, mostly men. Even in the summer, when, as stated, all subgroups showed a retiring mode at midnight, the mean retiring time for the housewives was 11:31 P.M. and for professionals, 11:53 P.M., the 22 minutes' difference being on the borderline of statistical significance. In the winter, however, the mean retiring times for the two subgroups were 10:02 P.M. and 11:05 P.M., and the difference, nearly three times as great as in the summer, was of definite statistical significance.

Three-fifths of the 90 respondents who supplied information on the subject stated that, as a rule, they found it easy to fall asleep in all seasons, but 48 persons noted a seasonal difference in this respect. Of the latter, 34 could go to sleep with greater ease in the winter, 14 in the summer. It will be recalled, however, that the few who had to use hypnotic drugs did so predominantly in the winter.

Among the reports concerning seasonal differences in sleep in the northern regions of Norway and Sweden were personal communications from local physicians citing complaints of patients. Perhaps the most extensive study of this subject was made by Dr. Erling Skouge, who analyzed medical history records of 1000 patients (including 90 children six years of age or younger) who resided in the counties of Troms, Finnmark, or the northern half of Nordland, between 68° and 71°N. Of these, 471 were troubled (163, markedly so) by sleep disturbances during the period of winter darkness. The complaints were not of an inability to sleep, but rather of a shift in the hours of sleep. They were, in Dr. Skouge's words, sleep-rhythm disturbances (Schlafrhythmus-Störungen). The shift was usually in the direction of a later onset of sleepiness, but without a decrease in the duration of sleep, except when the individual was obliged to get up early in the morning. Percentage-wise, these sleep disturbances were more frequent in men than in women; in adults than in children; in "immigrants" from southern counties than in the indigenous population. On the other hand, an analysis of 514 medical history records from residents of the counties of Vestfold, Agder, or Rogaland, located in the extreme south of Norway, between 58° and 59.5° N. showed only seven complaints pertaining to sleep in the winter.

Getting up. By contrast with the seasonal difference in the time of retiring for the night, the percentage distribution curves for the hours of arising in the morning (Fig. 1B) are practically superimposable. With ranges of 5 to 8:30 A.M. in both seasons, the mode in the summer (22 per cent) was at 7 and that in the winter (24 per cent), at 7:30. The corresponding means for the two seasons were 7:02 and 6:57 (Table 1, B). It can also be seen

that there were only small differences in the time of arising of the subgroups, and these were of no statistical significance. However, housewives who went to bed earlier also got up earlier, both in the summer and in the winter.

Over one-third of the subjects did not wake up during the night; the remainder did so occasionally, but no more often in the summer than in the winter. The mood on getting up in the morning did show a slight seasonal difference: in the summer 32 per cent of those who answered this question felt "tired or sleepy" and 42 per cent were "wide-awake, alert, in good spirits"; in the winter the respective percentages were 41 and 24. It appears that, in spite of much longer sleeping hours, fewer of the respondents were wide-awake in the morning during the winter months. This is in line with the winter shift in the hours of sleep, as reported by Dr. Skouge.

Duration of sleep. The mean figures were derived in two ways, showing consistent differences. First, the hours *spent in bed* were obtained by determining the time that elapsed between retiring at night and arising in the morning. Thus reckoned, the duration of sleep in the summer was 7 hours 26 minutes, and in the winter, 8 hours 25 minutes. Professional persons slept less than housewives, particularly in the winter (Table 1, C1). Second, the subjects' own estimates of how many hours they *slept* per night, in the summer and in the winter, were tabulated and their means obtained (Table 1, C2). A glance at Figure 1C, showing the frequency distribution curves for the duration of sleep in the two seasons, as estimated by the respondents, reveals a distinct mode at 7 hours in the summer, and an undulating plateau for 7 hours and longer, in the winter. The two seasonal curves cross between 7½ and 8 hours, with 56 per cent sleeping 8 hours or more in the winter, but only 22 per cent sleeping that much in the summer. The mean values, and seasonal and occupational variations, from the subjects' estimates, are consistently lower than the figures derived by the first method. This discrepancy may be due, in part, to the fact that (*a*) the estimates were of hours slept, which were shorter than hours spent in bed, and that (*b*) in determining the mean values for the duration of sleep from respondents' estimates, "9 hours or more" was treated as 9 hours, and "5½ hours or less," as 5½ hours, and, with a much larger percentage of the former in the winter and the latter in the summer, the winter means are probably smaller and the summer means larger than they should be. In any case, the mean of 47 minutes for the increase in the duration of sleep in the winter, relative to the summer, though smaller than the 59-minute increase in the time spent in bed, is statistically highly significant. So are the increases in the mean duration of sleep of the professional people and housewives, but the differentials for the subgroups, in either season, though consistent with the corresponding differences in time spent in bed, are not statistically significant.

Discussion of results. The data furnished by the questionnaires confirmed the information obtained by direct observation and were totally at variance with the reports of travelers. The citizens of Tromsø, and undoubtedly those of other towns in the Scandinavian Arctic, follow the same diurnal sleep-wakefulness pattern as does the general population of civilized communities in other parts of the world. As elsewhere, the customary routine of living sets the hour of getting up in the morning. Although the range is considerable (5 to 8:30 A.M.), it is the same throughout the year, and the percentage distribution of the hours of arising is practically identical for summer and winter. Professional people do get up a few minutes later than the other subgroups, but they sleep less. Real and statistically significant seasonal and subgroup differentials were found, however, in the hours of retiring for the night. After-work hours afford individual choices in activity everywhere, but more so in Norway, where community business, by and large, is over in the middle of the afternoon. As could be predicted, advantageous light and climatic conditions prompt Tromsøites to stay up later in the summer than in the winter. "Wakefulness-of-choice," the concept developed in the evolutionary theory of sleep and wakefulness,[1] applies especially to the utilization of leisure time. The onset of sleep has long been looked upon as an "escape from boredom," and there is no doubt that there must be something of interest to keep one up late at night. This factor is revealed with particular clarity in the variation in the retiring hours of the subgroups. Whereas the group, as a whole, retired, on the average, a full hour later in the summer than in the winter, professional people, with their greater ability or eagerness to follow leisure-hour pursuits, consistently stayed up later than did the housewives. The 22-minute mean disparity in the going-to-bed times of these two subgroups in the summer, barely significant statistically, was increased to 63 minutes in the winter, when cold and darkness discouraged outdoor activities, and the "inner stimulus" to the maintenance of the waking state met its greatest challenge in the sleep-inducing seasonal gloom. Again, it will be recalled that the sleep-rhythm disturbances, revealed by Dr. Skouge,

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were more prevalent among "immigrants" from the South, with a large proportion of professional people.

With the community getting-up time fixed the year around, and a later hour of retiring in the summer, it is inevitable that the duration of sleep should be shorter in the summer than in the winter. But how to interpret this seasonal differential? Did the subjects *need* more sleep in the winter? Or, did they sleep longer simply because they had no strong incentive to stay up and therefore retired earlier? The latter alternative appears to be the more plausible one, since, as will be recalled, in spite of a greater duration of sleep, only 24 per cent were "wide-awake" on getting up in the morning in the winter, compared to 42 per cent in the summer. Furthermore, the distinct mode at 7 hours in the frequency distribution curve for the duration of sleep in the summer (Fig. 1C), and the general uniformity of the means for the length of sleep in the summer for the subgroups suggest that 7 hours is perhaps a physiological modicum, sufficient for rest and recuperation. A longer night's sleep represents "luxury consumption," to borrow a dietetic term, or "escape from boredom," or some other combination of extraneous nonphysiological factors. In other words, given something of interest to occupy oneself, it should be possible for the "average" adult to remain awake for 17 hours out of 24. Of course, this does not preclude individual variations, as the spread even in the small sample studied was from less than 5½ to more than 9 hours of sleep per night, both summer and winter. The results of the survey, however, challenge the proverbial recommendation of 8 hours of sleep for the average normal adult.

That the mean duration of sleep of human beings is under 8 hours was demonstrated in figures obtained on 31 subjects, in Chicago, several years ago.[4] These persons, all adults, also slept least in the summer, but the seasonal variation was rather small. Disregarding seasons, the mean duration of their nightly sleep was 7 hours 32 minutes. It increased, on the average, to 8 hours 7 minutes, when they retired earlier, and fell to 6 hours 48 minutes, when they stayed up later than usual. Thus, a mean differential of 79 minutes in the duration of sleep was effected through a variation, by choice or necessity, in the time of retiring for the night. Their getting-up time was also influenced by choice or necessity, and it was found that they slept, on the average, 7 hours 44 minutes when they awoke spontaneously, but only 7 hours 13 minutes when they were awakened by an alarm clock or some other artificial means. For these subjects, as for the Tromsøites, the duration of sleep was increased from 7½ to over 8 hours, as a form of luxury, but necessity brought it down to around 7 hours.

To summarize, the data on the sample of the inhabitants of Tromsø, Norway, where the sun does not set during the summer and where continuous darkness prevails in the winter, show only a slight deviation from the sleep-wakefulness pattern that characterizes the diurnal routine of living in civilized communities in middle latitudes, and incidentally reveal that an average of 7 hours of sleep per night is probably compatible with the maintenance of well-being in human adults.

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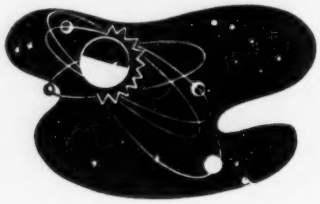

BOOK REVIEWS

STUDY OF MAN

Anthropology Today; An Encyclopedic Inventory. A. L. Kroeber, Chairman. Chicago: University of Chicago Press, 1953. xv + 966 pp. $9.00.

THERE can be no doubt that this volume is one of the most important books ever published in the anthropological field. Certainly it has no peer as the "encyclopedic inventory" it claims to be, and for years to come it will remain one of the most consulted and cited works bearing on the study of man. Nothing like it has ever been published.

To appreciate the scope of this book one should learn how it came to be planned and brought to fruition. In 1951, on its tenth anniversary, the Wenner-Gren Foundation for Anthropological Research, sponsor and supporter of the anthropological sciences, decided that it would need some sort of guide in the formulation of its future philanthropic policies. It felt that developments in the field had been snowballing too fast for it to evaluate its own efforts, and it hit upon the idea of getting its bearings through an international symposium. After elaborate planning, begun in 1951, with Alfred L. Kroeber, dean of American anthropologists, at the helm, such a meeting was held in New York on June 1952. As bases of discussion, fifty-two contributors prepared fifty so-called inventory papers, two of which were joint efforts. A total of eighty scholars from the United States, Europe, Latin America, Japan, India, Thailand, and Australia met and discussed for a fortnight the problems raised in these papers.

The numerous items in the present volume cover the whole range of anthropology and could not be reviewed as individual units even in a more ambitious review than this. Suffice it to say that the first group of articles deals with the problems of the historical approach and is made up of three papers on method, thirteen on results, and five on theory. The second group deals with problems of process and includes five papers on method, eleven on results, and three on theory. The third and last group deals with problems of application and includes nine papers. Appended is a special paper surveying the history of the technical aids in anthropology. Perhaps a more informative way of describing the content of these writings is to say that they deal with the present status of physical anthropology, ethnology, social anthropology, archaeology, linguistics, and applied anthropology. Their scope is, of course, enormous and can be justified and understood only by bearing in mind that the *raison d'être* of anthropology is its special way of looking at man-study. That way is the comparative method. Anthropology dares to invade the fields of history, economics, psychology, sociology, government, jurisprudence, genetics, and the other disciplines dealing with man because it examines him in all his diversified manifestations and reduces them to common denominators. The comparative method is anthropology's substitute for experimentation.

What does the inventory show? Alas! This is impossible to state, both because of the limitations of space and the enormity of the task. As a matter of fact a companion piece, entitled *An Appraisal of Anthropology Today* (University of Chicago Press, 1953), has been published on this very subject and contains the verbatim comments of the eighty participants in the symposium; but even it does not succeed in making an over-all estimate.

Although, in general, each paper in the present volume has been prepared by the most competent man in the field, there are puzzling exceptions. These, however, are in the minority and may be excused as resulting from practical coansiderations rather than bad judgment. The quality of *Anthropology Today* is indisputably superior, and if names need to be mentioned there are those of such scholars as Caso, Chapple, Childe, Grahame Clark, Forde, Kluckhohn, Lévi-Strauss, Mead, Redfield, Teilhard de Chardin, Stith Thompson, Vallois, and Weinert.

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MAN AND MEDICINE

The Infirmities of Genius. W. R. Bett. New York: Philosophical Library, 1952. 192 pp. $4.75.

THE giant redwoods of the Pacific slope are noted for the ugly burn scars that mar the trunks of many of them. The huge holes, sometimes extending entirely through the trunk, make one wonder how the trees survived such extensive injury. And yet there the redwoods stand, majestically dwarfing all other life around them.

We might postulate upon the possible reflections of some early explorer who first gazed upon a grove of such scarred redwoods. Perhaps he wondered whether the ugly scars were not something more than a manifestation of the unquenchable life potential of the trees; that the injuries in some way even stimulated the growth, or were the instruments for selection of the fittest of the species. Or perhaps, he noted that under foot was lesser vegetation that was withstanding privations relatively as great, but causing no wonder because of its insignificance. And, upon continuing his exploration, he would have come to another grove, with redwoods just as tall and broad, but devoid of any injury. Then perhaps the explorer would have sighed, discarded his reflections, and remained satis-

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fied with the mere privilege of beholding their beauty.

Similar reflections are inevitable upon reading the slim, delightful essays Dr. Bett has put together about the infirmities, real or imagined, of thirteen English and two French giants of literature. Without dwelling upon the indefinable and yet recognizable features of genius, there would be little disagreement on whether the fifteen subjects selected fulfill the criteria. Except for this feature, however, there is little in common in regard to their physical or psychological troubles. And one can only wish that there had been included for comparison a few perfectly normal literary geniuses—if there be such specimens and if there be such a state as normalcy.

In some of the case histories, the relationship between the disease and the art is only too clear, although even here it is impossible to distinguish between the cause and the effect. The alcoholic Poe, the addicts De Quincey and Baudelaire, reveal their frustrations and insecurities in their writings. But neither the psychological infirmities, nor the drugs by which they sought to alleviate them, can explain the nature and the extent of their genius. These factors merely exteriorized and perhaps gave certain directions to their genius. The malevolent Pope and the debauched Byron certainly were influenced by their physical deformities, and this influence is revealed in their writings. Yet the deformities offer no clue to the source of their genius. The tuberculosis of Keats and the rheumatic heart disease of Burns appear as accidental incidents without apparent influence on the art, despite Dr. Bett's perpetuation of the old fable regarding some more direct biochemical connection between the tubercle bacillus and literary brilliance. And at least two examples are given in which the literary achievements seem to be antithetical to the man and his environment: the lusty songs of Whitman, and his inversion, and the gentle work of Lamb, and his insane household.

Even among the fifteen selected cases, is the incidence of psychopathology any higher than could be found among fifteen individuals selected for their mediocrity? The bellyaches of Carlyle, recorded in his Gargantuan style, attract attention through his descriptions and because Carlyle was involved, and not because they were any more severe or more personally influential than the peptic ulcer of a businessman detailed by an interne in a hospital chart. The sexual peccadilloes of Burns, Shelley, or Byron are interesting and presumably important because they were involved, whereas those of more common citizens are either their unrecorded private affairs or mere statistics on Kinsey's punch cards.

Whether the defects of these men have as causal connections to their genius as are implied in the essays is, at least to this reviewer, a matter of opinion and unestablished conjecture. It may be, in reverse, a demonstration that genius cannot be thwarted even by fatal disease, disabling psychological quirks, or the most hostile of environments. Perhaps—and this is pure heresy in the era of psychosomatics and psychoanalysis—perhaps here we are given a glimmer that there is something bigger and better than man, although through man it is manifest.

M.B.S.

Great Adventures in Medicine. S. Rapport and H. Wright. New York: Dial Press, 1952. 874 pp. $5.00.

THIS is really quite an amazing potpourri of medical excerpts, articles, statements, and other selections, arranged in six approximately historical parts, with a short synopsis for each part. There seems to be no central focus or criterion for the choice of the items. Accounts of their discoveries by Koch and by Pasteur are followed by selections from Dickens and Conan Doyle. There are some pages of ancient and medieval remedies; Francastoro's poem on syphilis; twenty-two pages about Johns Hopkins and Osler, including a humorous poem; excellent, concise reviews of the histories of yellow fever, pellagra, and other diseases; and looks into the future and beyond.

The unevenness of the compendium certainly contributes to its informality, and it is not a doctor's book about doctors. The description of the plague by Boccaccio can be compared with a description of trichinosis from the *New Yorker,* not only from the standpoint of the advance in medicine in six hundred years, but as examples of literary and journalistic styles of the fourteenth and of the twentieth centuries.

The authors must have had a lot of fun gathering the material, and it is a lot of fun to read, no matter where one starts. One might wish for the inclusion of more selections from the historical giants such as Galileo, Newton, and Francis Bacon, for better representation beyond the boundaries of the United States, England, and France (neither Virchow nor Pavlov is present), and for fewer contemporary papers that obviously are going to fade in the stretch.

This is just the book to present to a nephew in college who is considering medicine as a career, or to take on a summer vacation. For that matter, it would also serve as a good jumping-off place for a seminar-type course in medical history. But for any purpose, it should be read under the best illumination, for the publishers have crammed every page with as many lines as the small print would allow.

MICHAEL B. SHIMKIN

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FIFTY-YEAR SUMMATION

Diseases in Plants. Neil E. Stevens and Russell B. Stevens. Waltham, Mass.: Chronica Botanica, 1952. xx + 219 pp. Illus. $4.75.

THIS introduction to general plant pathology departs from the handbook type of presentation often followed in college texts. Instead of describing an array of plant diseases, with excursions into elementary bacteriology and mycology, the authors give a general ac-

count of the science—drawing upon the entire field for their evidence and illustrative material. Because of the great quantity of information on plant diseases to be covered, the book is very much condensed, almost to syllabus form. With a good teacher, it should be both a stimulating and a challenging text for students.

The preface indicates that much of the manuscript was essentially complete at the time of death of the senior author. To his son, also a professor of plant pathology, fell the task of coordinating and arranging the abundant material. But many of the topics that are stressed—plant disease survey, epidemiology, plant disease losses, plant quarantines, *inter alia*; the fascinating phytopathological lore and curiosa included here or there; the references to cranberry diseases; the insistence on the strong relationship of plant pathology to national and world affairs—were encompassed in the thinking and lifework of the dynamic senior author, who speaks again in this fine book.

The authors deal with general pathology under four main subdivisions: an introduction, a section on causal agents of plant diseases, a section on development of pathogenic diseases, and the final one on disease control. In the introductory section, the world food problem is briefly outlined, and then the losses from plant diseases are considered in this frame of reference. The authors sum up the matter thus: "This, then, is the real problem which faces plant pathologists in relation to the public welfare; that of protecting a vital source of foods from serious and in large part preventable destruction." In a seven-page chapter of this section, the effects of disease on the plant body and on the root, stem, and leaf are briefly sketched. The authors' concept of plant disease is any impairment of structure or process sufficient "to noticeably or permanently affect the normal development of the plant." Normalcy, however, is not defined.

In the second section of the book, under the general heading "Causal Agents of Plant Disease," the titles of the chapters are: The Viruses; Bacteria and Fungi; Flowering Plants, Nematodes, and Insects (*sic*); and Nutritional Factors, Climatic Effects, Chemical Injury. The third section of the book discusses the host plant, the pathogen, the effects that weather and soil have upon disease development, the relationships of insects to plant disease, and variation and physiological specialization in plant pathogens. This section closes with a chapter entitled Introduced Hosts and Pathogens. The final section of the book, devoted to disease control, considers the economics of disease control; fungicidal treatments; seed and soil treatments; sanitation, eradication, and quarantine; and breeding for disease resistance. There is a chapter on Market Pathology. The book closes with a nondescript chapter entitled Handling Plant Disease Problems, whose topics in any later edition could well be reassigned to other sections. From this brief scheduling, it will be seen that the authors have achieved a very satisfactory organization of subject matter. By virtue of two indexes, the one general and the other for persons, information is readily accessible.

Many years ago, in their preface to the famous University of Chicago *Textbook of Botany*, Coulter, Barnes, and Cowles disclaimed that the volumes were written for their professional colleagues; all teleological implications were expressed disavowed, and it was pointed out that the authors sought to develop certain general concepts thought to be fundamental rather than to present an encyclopedic collection of facts: "This purpose," they said, "has demanded occasionally also a greater apparent rigidity of form in general statements than is absolutely consistent with all the facts." So, too, in this book written for students—probably undergraduates—we must not always expect the critical professional viewpoint, or the stressing of exceptions and alternative hypotheses, but rather a certain positiveness of statement. We also must expect what to the professional may seem glaring omissions, together with occasional overemphasis of new and intriguing phases.

With such guidelines, the book is certainly very acceptable. It has few errors of consequence. The attention given to the various topics often seems disproportionate to their relative significance in phytopathology. Thus the viruses, as causal agents, receive more discussion than the bacteria and fungi. Market pathology is discussed in greater detail than breeding for disease resistance. The map entitled "Agricultural Research in United States" (Fig. 60) contributes little. The size of virus particles is given in microns where millimicrons are meant. There is a tendency to include speculative and untested information where the subject matter had special appeal to the authors. In many places the diction is jerky; in a few places the statements are clumsy, almost as if too sweeping a comment had originally been written and then, upon review, this was modified by some saving phrase or qualifying word. All these relatively minor shortcomings can be ironed out in any later edition.

The most serious criticism this reviewer would make deals with the references to phytopathological literature. In considerable part, these seem to be readily available sources for checking purposes rather than to the original researches. As a result, many of the great names in plant pathological science are not put before the student; often he is not directed to the most important contributions. The literature references occasionally are to nonscientific or ephemeral publications. A more scholarly bibliography would, in the reviewer's opinion, enhance the usefulness of the book.

With purpose, the authors chose the same title for their book as was used by H. Marshall Ward, the great English plant pathologist, a half-century before. The first book was an authoritative discussion of the principles of plant pathology, and in the early days of the science had great formative influence. It is therefore not without interest to contrast the precursor volume with the present summarization, now that plant pathology has taken its place beside plant physiology as an independent botanical discipline.

Ward had available a relatively meager store of phytopathological information. He could discuss the

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necrotic diseases, drawing chiefly upon their mycological characteristics. Similarly, the smuts and rusts could be described as fungus entities, but the rusts showed heteroecism and evidence of specialization into races. As additional subject matter, Ward dealt also with nutritional effects and nonpathogenic diseases, with late blight of potato, club root of crucifers, and with the various galls, excrescences, malformations, and injuries of trees and other plants. Bacterial diseases of plants were not included, although this field of research had been opened by T. J. Burrill, J. C. Arthur, and E. F. Smith. Nor does Ward mention virus diseases, although tobacco mosaic and other virus diseases had long been known. M. W. Beijerinck's classic work was published in 1898, but, as we know, it remained largely unapplied until H. A. Allard's researches in 1914 broke with accepted theories and opened the entire field for investigation. The full development of topics possible in Ward's book, as contrasted with the epitomization and omissions required in the later volume, dramatically portrays the enormous increase in our knowledge of plant pathogens.

Ward used nearly one third of his book to acquaint the reader with the elements of plant physiology, stressing plant nutrition and photosynthesis—chlorophyll was not then a household word. He needed to correct certain fallacies as to gas exchange in plants and the circulation of sap. He needed to bring to his readers the new studies on cellular mechanics and physiology. As a student of Julius Sachs and Anton de Bary, this he was well fitted to do. In discussing hybridization and selection, only a four-line mention was made of Mendel's law, just rediscovered, attention being devoted chiefly to W. Rimpau's experiments with wheat. The authors of the book under review very properly saved space by assuming that botanical fundamentals are now common knowledge with students. Ward devoted a chapter to breeding for disease resistance. His approach was chiefly theoretical. He was hopeful of possible accomplishments, but he assessed properly the difficulties that would arise because of specialized races of the pathogens. Not a single "disease-proof" variety was named by Ward. The succeeding half-century witnessed the application of disease-resistance breeding as a most effective control measure for plant disease. From a wealth of such material, the Stevenses have space for only a few striking examples.

As Ward presents it, disease is related to the plant's response to impinging environmental factors, especially if these go beyond its capacity for prompt adjustment. This concept of the equilibrium that the plant tends to maintain with its surroundings focuses attention on the disease factor as the disturber of this equilibrium. Our present viewpoint on plant disease causation, which, of course, Ward helped to mold, does not differ essentially from this interaction concept. Ward stressed that disease was a cell reaction brought about by lack of nutrition, water, or other environmental factor, or by the presence of a disturbing agent. The disease should not be confused with agent or the symptoms with the maladies—obvious, of course, but a thing that each new crop of phytopathologists apparently must rediscover. Ward stressed the living cell as the center of interest; he described the healing processes of tissues after wounding occurs; the stimulation of cell activity as a function of the natural irritability of protoplasm. The parasite may produce its effects through toxic substances—as, for example, the predator fungi—and through enzymes, among which he lists cytases, the diastases, and proteolytic enzymes. Chemotropism is the effective force directing the parasite. Parasitism, as Ward sees it, is a stage beyond epiphytism in that the parasite invests and invades the cells, establishing food and water relations with the host. These generalizations of the pioneer volume find no counterpart in the present book except as a detail here or there can be pieced together to form a philosophy on the nature of disease and its causation. We must not charge this solely to the authors but include the investigators themselves, who seem to have been so preoccupied with factual details they have not found time to ponder or even to speculate.

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BRIEFLY REVIEWED

Ultraviolet Radiation. Lewis R. Koller. New York: Wiley; London: Chapman & Hall, 1952. 270 pp. $6.50.

ULTRAVIOLET radiation nowadays plays a great role not only in physics, but also in biophysics, biology, chemistry, climatology, and medicine. The literature about the subject is dispersed over many journals, and sometimes it is very difficult to find quick and reliable information. A monograph on ultraviolet radiation, written by a competent research man in this field, therefore will be welcomed by all scientists specializing in one of the fields mentioned above.

An introductory chapter covering historical facts, fundamental definitions, and concepts is followed by three chapters dealing with the ultraviolet radiation of arcs, incandescent sources, and solar radiation. Two additional sections are devoted to transmission and reflection properties of numerous materials, wherein most of the data are presented in graphical manner. A chapter on applications and effects of ultraviolet radiation covers biological aspects as well as problems of illumination. A chapter on detectors of ultraviolet radiation concludes the book, which indeed fills a gap in the literature on radiation.

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French Inventions of the Eighteenth Century. Shelby T. McCloy. Lexington: University of Kentucky Press, 1952. viii + 212 pp. Illus. $4.50.

IN ATTEMPTING to write the history of technology on a national basis, the author has not been able to avoid the pitfalls inherent in this method. Science and technology have an international history, and French technology of the eighteenth century can be assessed only as a part of European technology of the period. The author is well aware of the fact, and in several chapters, such as those dealing with the balloon, steam transportation, the telegraph, lighting, papermaking, and textiles, he has managed to inform us of eighteenth-century technology and the special part France played in this development. In other chapters, such as those on chemical inventions, automata and other mechanical devices, military inventions, medicine, and surgery, his method has produced a selection of French improvements or variants rather than basic inventions and an anecdotal arrangement of material that leaves the general reader in the dark about the true place of these inventions in their field of technology or of science.

It is a great pity that McCloy tried to cover so many fields instead of selecting a few specific ones to illustrate why France, with her brilliant thinkers and inventors, did not experience an industrial revolution such as marked eighteenth-century Britain. Neither do we hear all the reasons why France failed in the mechanization of her industry. The apathy of the French bankers and of the bourgeoisie, the state-imposed "manufactures" as a result of Colbert's measures, and several other such factors are not sufficiently stressed. This is a great pity, the more so because the author has unearthed much original French evidence and in his excellent bibliography has given us access to many more sources. We hope that in the next edition of a book very useful for the many data it presents the author will be able to recast his material and, by selecting a few prominent examples only, will prove the thesis he set out to discuss —the failure of eighteenth-century France to industrialize as Britain did.

R. J. FORBES

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Phosphoric Acid, Phosphates and Phosphatic Fertilizers. 2nd ed. William H. Waggaman. New York: Reinhold, 1952. 683 pp. Illus. $15.00.

IN THE second edition of his book, the author offers a very complete and up-to-date coverage of all aspects of the phosphate mining and processing industries. This makes an ideal handbook for those engaged in the phosphate industry; it will also serve as an excellent reference book for those engaged in related industries.

The first part has individual chapters describing each of the main phosphate deposits of the world. Where the author was not thoroughly familiar with the deposit he has asked those who were to write the chapter. The known extent of each deposit, together with the characteristics of the rock, are adequately presented.

A large section of the book deals with the phosphate recovery processes and the processes involved in the manufacture of the various phosphates. The manufacture of phosphate fertilizers is the main use which is made of phosphate rock. Separate chapters deal with each of the various types of phosphate fertilizers; for each the author shows the different processes involved and the kinds of machinery used. For each process also, he has given a breakdown of the cost of production.

Although the major portion of the book deals with the phosphate industry, the other uses of phosphate are considered. The methods of production for the use of phosphates in water softening and cleansing, baking, sugar refining, and fireproofing are presented. The effectiveness of the phosphate compounds produced for these purposes is discussed.

The appendix contains a complete listing of the U. S. patents pertaining to the manufacture and use of phosphorus compounds. This enables anyone to become acquainted with the latest developments and also to determine what still lies open for further invention.

The book is written in a clear, direct, and interest-holding style. It will be valuable as a reference book for teachers and researchers in both chemistry and agriculture, and will make an excellent reference book on phosphate fertilizers for courses in fertilizers.

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The Immaculate Forest. W. R. Philipson. New York: Philosophical Library, 1952. 223 pp. Illus. $4.50.

THE Macarena Mountains, a range east of the Andes in Colombia, isolated, uninhabited, and practically unknown, were the goal of W. R. Philipson and his English and Colombian associates. The author, himself an eminent botanist, was interested chiefly in the flora, but made a great many observations on other phases of natural history.

All forms of travel were used—an airplane to get the layout of the land, mules, launches, canoes—but the actual journey to the mountains was made on foot, hacking a passage through the forest, wading streams populated with electric eels, sting rays, and caimans—far different from paddling in less-infested waters.

The Immaculate Forest is a detailed day-by-day journal of the trip, which followed the range until opposite the peak. Camp after camp was made, packing food and hammocks, and sorties were made from each camp, felling trees and collecting specimens. In a tropical jungle, as the author points out, plants, like the monkeys, have taken to the trees, and the branches take the place of solid earth, for on them sometimes more herbaceous plants grow than in the soil itself.

There were encounters with ants, wasps, and the

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ubiquitous sweat bees, but many encounters were more pleasant. Game was plentiful and so completely unafraid it practically walked into the camps. Wild pigs, curassow, and tinamou supplied excellent meat, and the zoological collectors brought in such rarities as the giant armadillo and the spectacled bear, as well as an enormous jaguar.

Eventually, after several attempts, the party actually reached the peak, about 5500 feet high, and made extensive collections there. Other naturalists will look forward to the scientific results of this work.

In addition to the fight to ascend the mountain, other trips were made; an interval was spent in semiluxury at El Mico Ranch, where the party lived the life of typical *lanneros;* and they flew in a Catalina plane to Leticia, the Colombian outpost on the Amazon itself.

There are a number of excellent photographs, a good index—all in all, an excellent picture of dense jungle teeming with tame wild life, as seen through the eyes of a capable botanist.

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Essentials of Microwaves. Robert B. Muchmore. New York: Wiley, 1952. vi + 236 pp. Illus. $4.50.

THIS book starts with an introductory chapter that contains principally a brief discussion of the place of microwaves in the electromagnetic spectrum, in engineering, and in physics. The second chapter treats the general laws of electromagnetism, and electromagnetic waves. The contents of the succeeding chapters are indicated by the following list of subjects taken from either chapter or section headings: characteristic waves, wave-guides, resonators, filters, antennas, grid-controlled tubes, klystrons, traveling-wave tubes, magnetrons, noise, crystal rectifiers, microwave relays, radar, linear accelerators, spectroscopy, atomic clocks, measurements.

The exposition is nonmathematical; there are but 23 equations, and these have generally been given only as shorthand expressions for relations stated verbally. Derivations are not carried out in the usual sense, although the logic underlying particular derivations is indicated. The text is very well illustrated by some two hundred appropriate figures—an average of nearly one per page.

In summary, we have a compact review of the entire field of microwaves, with emphasis on physical principles and rigid de-emphasis of mathematical manipulations. An exposition of this type has entailed compromises, and it is probable that many readers will not be completely satisfied with all the explanations. The difficulty could hardly be avoided, but the same cannot be said for the occasional evidences of offhand writing. For example, one finds on page 100 the statement: "These natural substances can be employed as dielectrics to very high frequencies (until the wavelength becomes small compared to the molecules or atoms), e.g., light-wave or ultra-violet frequencies." Actually, of course, even for the near ultraviolet the wavelengths are hundreds of times greater than the dimensions of atoms or simple molecules.

Neither of the above criticisms should be taken to mean that the book falls short of fulfilling the purpose for which it is intended—to convey to the reader a feeling for the behavior of microwaves and an appreciation of the range of their application. The book reads easily, and provides a rapid and enjoyable means of becoming acquainted with the broad outlines of the subject.

F. F. Rieke

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Associated Measurements. M. H. Quenouille. New York: Academic Press; London: Butterworths, 1952. x + 242 pp. Illus. $5.80.

THIS book should be of aid to research workers who wish to demonstrate or test for the dependence of a variable on one or more other variables. Various tests, both graphical and analytical, are presented for determining whether dependence (or association) exists and, if so, what kind and what degree. Several tests of existence of association between two variables are given—such as Tukey's corner tests—which are not readily available in other books. The author approaches the general problem analytically from the analysis of variance and covariance standpoint.

A chapter on time series includes topics on serial correlation, elimination of trend, and various computing and testing devices. Multivariate analysis, the probit transformation, and many other topics are also treated. The book contains thirteen tables giving significance levels of various statistics, including the coefficient of medial correlation, number of pairs of points falling on the same side of the medial line, orthogonal polynomials up to the third order for $n = 3 - 12$, etc.

One should have had some contact with statistical methods in order to appreciate this book. It is written on an elementary level, and no derivations are given, but the book still contains a large amount of solid and valuable material. Throughout the book examples are solved which help to make the ideas presented concrete and understandable. A great deal of this content is not available in other books presuming the small background for the reader that this book does.

Teachers of elementary statistics might well use the book to present some ideas not ordinarily included in the beginning courses—ideas that are relatively simple, and certainly useful in application. The lack of problems for students to solve may well hinder its general use in the classroom, however.

Donald B. Owen

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Historic Researches. Chapters in the History of Physical and Chemical Discovery. T. W. Chalmers. New York: Scribner's, 1953. 288 pp. Illus. $5.00.

THIS collection of essays published in the British periodical *The Engineer* between 1944 and 1948 covers a wide range of subjects, such as friction, the mechanical equivalent of heat, electrodynamics, the ether drift experiments, heat, chemical elements and atoms, the classification of atoms, molecular physics, the conduction of electricity through liquids and gases, X-rays, positive rays, and isotopes. The choice was not accidental; the author explains that he chose these subjects because they had a direct bearing on modern engineering. He chose the historical approach because it had distinctive merits as a practical educative method apart from its intrinsic interest.

The author never indulges in journalese; his expositions are always scientific and hence one should not read this book lightly but study it carefully. The reader will be well rewarded for his efforts. One misses the usual bibliographical notes or bibliography. This is a pity, because many would like to follow up the author's exposition by reading the original treatises and handbooks. It is suggested that this defect be repaired in the next edition. The author has provided extensive biographical and mathematical notes, which give much information, rightly included as an appendix and not in the essays themselves. The book seems well worth its price and forms a welcome addition to the college bookshelf as an interesting historical introduction to aspects of modern physics.

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New Books Received

Acanthocephala of North American Mammals. Illinois Biological Monographs: Vol. XXIII, Nos. 1–2. Harley J. Van Cleave. x + 179 pp. Illus. $5.00, cloth; $4.00, paper. University of Illinois Press, Urbana, Ill. 1953.

Child Training and Personality: A Cross-Cultural Study. John W. M. Whiting and Irvin L. Child. vi + 353 pp. $5.00. Yale University Press, New Haven, Conn. 1953.

Manual of Comparative Anatomy (2nd ed.). Osmond P. Breland. xi + 256 pp. $4.50. McGraw-Hill, New York. 1953.

Mechanics of Fluids. Hunter Rouse and J. W. Howe. x + 245 pp. Illus. $4.50. Wiley, New York. 1953.

The Yields of a Crop. Based on an analysis of cotton-growing by irrigation in Egypt. W. Lawrence Balls. xv + 144 pp. Illus. + plates + charts. 21s. Spon Ltd., London. 1953.

Adventures in Artificial Respiration. Peter V. Karpovich. xvi + 303 pp. Illus. $7.50. Association Press, New York. 1953.

Contributions to the Theory of Games, Vol. II. H. W. Kuhn and A. W. Tucker, Eds. viii + 395 pp. Illus. $4.00. Princeton University Press, Princeton, N. J. 1953.

The Bile Pigments. C. H. Gray. xv + 142 pp. Illus. $1.75. Wiley, New York. 1953. (Printed in England.)

Conferences on Drug Addiction Among Adolescents. Sponsored by the Committee on Public Health Relations of the New York Academy of Medicine, Nov. 30, 1951 and March 13–14, 1952. xvi + 320 pp. $4.00. Blakiston, New York. 1953.

Our Physical Environment: A Problem Approach. Leonard W. Gaddum and Harold L. Knowles. ix + 625 pp. Illus. $5.50. Houghton Mifflin, Boston, Mass. 1953.

A Textbook of General Botany (5th ed.). Gilbert M. Smith *et al.* x + 606 pp. Illus. $6.25. Macmillan, New York. 1953.

The Roots of Psychotherapy. Carl A. Whitaker and Thomas P. Malone. xvii + 236 pp. Illus. $4.50. Blakiston, New York. 1953.

Plant Morphology. Arthur W. Haupt. ix + 464 pp. Illus. $8.00. McGraw-Hill, New York. 1953.

Between the Tides. Philip Street. 175 pp. Illus. + plates. $4.75. Philosophical Library, New York. 1953.

Science in Daily Life. Francis D. Curtis and George G. Mallinson. xii + 570 pp. Illus. $3.96. Ginn, Boston, Mass. 1953.

College Chemistry: A Systematic Approach. Harry H. Sisler, Calvin A. VanderWerf, and Arthur W. Davidson. x + 623 pp. Illus. $5.25. Macmillan, New York. 1953.

Logic and Language (2nd series). A. G. N. Flew, Ed. vii + 242 pp. $4.75. Philosophical Library, New York. 1953.

The Epidemiology of Health. A New York Academy of Medicine book. Iago Galdston, Ed. ix + 197 pp. $4.00. Health Education Council, New York. 1953.

Introduction to the Theory of Statistics. Victor Goedicke. xii + 286 pp. Illus. $4.50. Harper, New York. 1953.

A Herd of Mule Deer. A record of observations made on the Hastings Natural History Reservation. Jean M. Linsdale and P. Quentin Tomich. xiii + 567 pp. Illus. $8.50. University of California Press, Berkeley. 1953.

Introduction to Geometrical and Physical Optics. Joseph Morgan. xi + 450 pp. Illus. $6.50. McGraw-Hill, New York. 1953.

Atoms, Men and God. Paul E. Sabine. x + 226 pp. $3.75. Philosophical Library, New York. 1953.

Science in Synthesis. A dialetical approach to the integration of the physical and natural sciences. William H. Kane *et al.* xii + 289 pp. $3.50. Dominican House of Studies, River Forest, Ill. 1953.

Vorstellungen vom Aufbau der Materie im Wandel der Zeiten. Fritz Lieben. x + 384 pp. $7.20. Franz Deuticke, Vienna. 1953.

Safer Smoking. Clarence William Lieb. 106 pp. Chart. $2.50. Exposition Press, New York. 1953.

Physics. Noel C. Little. viii + 648 pp. Illus. $6.00. Heath, Boston, Mass. 1953.

The Road to Abundance. Jacob Rosin and Max Eastman. vii + 166 pp. $3.50. McGraw-Hill, New York. 1953.

Plant Diseases in Orchard, Nursery and Garden Crops. Ernst Gram and Anna Weber. Evelyn Ramsden, Trans. 618 pp. Illus. + plates. $18.50. Philosophical Library, New York. 1953. (Printed in England.)

Cardano the Gambling Scholar. Oystein Ore. xiv + 249 pp. Illus. + plates. $4.00. Princeton University Press, Princeton, N. J. 1953.

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